NATURAL RESOURCES MANAGEMENT PLAN

SEQUOIA AND KINGS CANYON NATIONAL PARKS
AND
DEVILS POSTPILE NATIONAL MONUMENT

July 1974

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PREFACE

The need for a comprehensive plan for the management of the natural resources of the various areas of the National Park System has been recognized for some time. In Sequoia and Kings Canyon National Parks and Devils Postpile National Monument, no such plan has ever been approved. A portion of a plan was prepared in draft in 1969 but its completion, review and approval at the regional and national levels was never accomplished. As a result, many Resources Management activities have been conducted without the benefits of documented long-range, comprehensive planning. What has been needed is a planning document from which necessary programs could be translated into funds and then to action on a priority basis. The formulation of the present Resources Management Plan is an attempt to overcome this deficiency. It is an attempt to provide an overall framework for the programming and execution of natural resource management and research activities within these Parks. The Plan discusses management objectives, reviews the current status of the natural resources, identifies current problems which deter the achievement of these objectives, and outlines proposed action programs designed to accomplish the objectives described.

The Plan consists of a background discussion and outline of specific proposed action plans. These are presented under separate organizational headings. The Plan is supplemented by a series of requests for funding which present a more detailed account, including background justification and funding for each proposed action. A programming sheet is included which summarizes priorities, funding and time sequence of current and proposed projects over a five year period.

This Plan was prepared under the direction of Superintendent Henry G. Schmidt. It was written as a team action with Resources Management Specialist George S. Briggs as the key man and with the assistance of Fish and Wildlife Specialist Maurice J. Zardus, Research Biologist David J. Parsons, and Forestry Technician William F. Paleck. Park Trainee William W. Kantola is recognized for his special contribution to the Cave Management section. Additional input, comments and review were provided by other members of the Park Staff, especially Sierra District Ranger Gordon D. Boyd, and the Resources Management Plan Team of the Western Regional Office under the direction of Milton C. Kolipinski.

INTRODUCTION

Sequoia and Kings Canyon National Parks and Devils Postpile National Monument contain some of the prime natural resources of the western United States. The various acts of establishment, and related legislation, indicate that the primary purposes and objectives of these natural areas are to preserve and maintain for posterity all native plant and animal life and all other natural features found in the Parks which collectively typify the primitive wilderness environment of the Sierra Nevada. Particular emphasis is given to the preservation of the giant sequoia (Sequoiadendron giganteum). All management activities and research efforts in these areas are oriented towards these objectives.

The Establishing Act for Sequoia National Park (September 25, 1890) in setting aside some of the most magnificent of the sequoia groves, called for ". . . the preservation from injury of all timber, mineral deposits, natural curiosities or wonders . . ." and ". . . their retention in their natural condition". In addition, the Establishing Act for Kings Canyon National Park (March 4, 1940) provided that the Secretary of the Interior, ". . . in order to insure the permanent preservation of the wilderness character of the Park, may, in his discretion, limit the character and number of privileges . . ." within the Park. Thus, it is apparent that the purpose of both Parks is to perpetuate their environment in a natural state.

In 1963, the Leopold Report (Leopold et al. 1963) recommended to the Secretary of the Interior that a primary goal of National Parks should be ". . . that the biotic associations within each Park be maintained, or where necessary, recreated as nearly as possible in the condition which prevailed when the area was first visited by the white man. A National Park should represent a vignette of primitive America." The essence of these recommendations have since been incorporated into the management principles for the natural areas of the National Park Service. Specifically, the Administrative Policies for Natural Areas of the National Park System (1970) states that management activities in such areas ". . . will minimize, give direction to, or control those changes in the native environment . . . resulting from human influences on natural processes of ecological succession." It further states that ". . . native environmental complexes will be restored, protected, and maintained, where practicable, at levels determined through historical and ecological research of plant-animal relationships".

It is the above principles which now guide the management of natural resources as presented in this Plan for Sequoia and Kings Canyon National Parks and Devils Postpile National Monument.

In addition to the specific actions proposed in this Plan, it is recognized that a greatly increased attention must be given to accumulating basic information on all Park resources. Basic inventories of such resources as soils, small mammals, reptiles, amphibians and invertebrates are needed as a basis to fully understand the natural resources of the Park, are especially needed as these areas have received little attention.

RARE AND ENDANGERED PLANTS

The protection of rare and endangered plant species is a primary objective of Park Management. Given the directives that, ". . . missing native life forms may be reestablished . . ." and ". . . native environmental complexes will be restored, protected, and maintained . . ." (Administrative Policies) it becomes the responsibility of Park Managers to identify and protect those species threatened with extinction either from natural causes or from the disturbing influences of human oriented activities. In addition, native species previously found in these Parks but now missing, should be identified and recommendations made regarding their possible reestablishment.

At this time, very little is known regarding the existence or distribution of rare or endangered plant species in these areas. Any management actions must be based on specific knowledge of the species concerned.

Action Plan

1. An inventory must be taken to identify what rare and endangered plant species are found in these Parks, where they are located, and what their current status is. As a result of this inventory, recommendations will be made concerning how to best protect and, in some cases, reestablish the range of the identified species.

EXOTIC PLANTS

The existence of non-native plant species in National Parks is in conflict with the concept of a natural area. Administrative Policies states, "Non-native species may not be introduced into natural areas. Where they have become established, or threaten invasion of a natural area, an appropriate management plan should be developed to control or eradicate them where feasible."

Annual forbes and grasses first introduced over a century ago from the Mediterranean zone of Europe now constitute an important element of the herbaceous vegetation throughout these Parks. Grazing and other resource disturbing activities have contributed to the establishment of many exotics. In many such disturbed areas, native species have been almost completely replaced. In addition, such introduced species as Scotch thistle (Onopordum acanthium), foxglove (Digitalis purpurea), and common mullein (Verbascum thaspus) have recently become locally established as weeds throughout the area. A primary objective of Resources Management, at this time, is to control the spread of these exotics.

Action Plan

1. A thorough inventory of the distribution of all exotic plants in the Parks, including research into the history of the introduction and their present ecological role in the community will be carried out. Recommendations for the control and/or selective removal of non-native plant species by approved chemical and biological techniques will be made.

2. Cooperation with County and State weed control programs such as the ongoing program with Tulare County for the control of Scotch thistle by approved herbicides will be continued.

NATIVE INSECT AND DISEASE CONTROL

National Park Service policy related to native insect and disease control is stated in Administrative Policies as follows:

> "Native forest insects and diseases existing under natural conditions are natural elements of the ecosystem. Accordingly, populations of native insects and the incidence of native diseases will be allowed to function unimpeded except when control is required (1) to prevent the loss of the host from the ecosystem; (2) to prevent the complete alteration of an environment which is expected to be preserved; (3) to prevent the outbreaks of the insect or disease from spreading to forests or trees outside the area; (4) to preserve rare, scientifically valuable, or specimen trees or unique forest communities; (5) to maintain a suitable overstory, shade or ornamental trees of Class I and II lands . . ."

Man's developments and attendant activities predispose trees to attack by native insects and disease. Open wounds caused by axe marks, nail holes, vehicle accidents and other mechanical abuses provide inviting avenues for infection by native disease and infestation by native insects. Research has shown that the odor emitted by the oleoresins in sap exuded by a wounded tree acts as a powerful attractant for many native insects. Environmental modifications caused by soil compaction, loss of ground cover and construction often lessens tree vigor which increases the chance of successful insect attack when it occurs. Control of native insects in these areas is required to prevent loss of trees which can diminish or nulify the purpose of the developments. Centers of insect infestation increase in both size and intensity if they are not controlled on a regular basis. In addition, insect-killed trees become both fire and public safety hazards if they are not removed as they occur (Figure 1).

Unnaturally high insect or disease populations in developed areas, if uncontrolled, can easily spread to adjacent forest stands unmodified by developments. Thus, control achieves protection not only of stands growing under the modified conditions of developed areas, but stands growing under natural conditions as well.

FIGURE 1
PHOTO OF INSECT KILLED TREE

Action Plan

1. The detection, removal and/or chemical treatment of serious insect pests such as mountain pine beetle (Dendroctonous monticolae), western pine beetle (D. brevicomis), red turpentine beetle (D. valens), and Ips (Ips. spp.) will continue. The area subject to control is the zone of developments and a narrow strip immediately contiguous to these areas (approximately 6,000 acres total). U.S. Forest Service entomologists and pathologists, technical advisors to the National Park Service in such matters, recommend this strip as it lessens the chances for successful bark beetle attack within the zone. Intensive spotting surveys are conducted each spring and fall over the total control area to detect trees infested with insect pests. Any unusual forest disease conditions are also noted. Suppression work immediately follows positive reports from the spotting surveys. Infested trees are treated with pesticides approved by the Environmental Protection Agency. All chemical applications are made only by skilled technicians trained in the safe handling and use of chemicals relative to public health, wildlife habitat, vegetation and aquatic resources. The guidelines for tree removal and protection of the environment noted under "Tree Hazard Abatement" are followed. All work performed is completely documented.

2. Dwarfmistletoe (Arceuthobium spp.) is a dioecious parasitic plant reproducing and spreading by means of forcibly ejected seeds. Coniferous trees of any age may be deformed or killed, with the greatest mortality among seedlings and saplings. Lodgepole and ponderosa pines, and red firs, are particularly susceptible to killing. However, the greatest impact of the dwarfmistletoe is in reducing tree vigor and rate of growth. It is a serious problem in the Cedar Grove area where it requires periodic surveillance surveys to identify the extent of the parasite and pruning to effect control.

3. Fomes annosus, often called "butt rot" and "brown rot", is a disease which spreads naturally by mycelium growing through the soil or by spores washed into the soil or carried by rodents or wind. Cut surfaces of green trees easily become infected allowing the disease to spread through interconnected root systems. As outlined under "Tree Hazard Abatement" the surfaces of all green tree stumps will be treated with Borax (sodium tetraborate) to prevent innoculation of stumps by the disease.

4. In conjunction with overall Park policy noted above, surveillance for development of epidemic levels of insect infestations

and disease in areas outside designated control zone will continue to be conducted. Plans for the control of forest insects and diseases are prepared and executed, when required.

For example, should wildfire temporarily create a condition which favors the development of an epidemic population of bark beetles, a program to retard and restrict the epidemic may be required.

EXOTIC INSECTS AND DISEASES

National Park Service policy is explicit on the matter of exotic diseases. The policy as contained in Administrative Policies states, "Where non-native insects or diseases have become established or threaten to invade a natural area, appropriate measures will be taken to control or eradicate them where feasible." At this time, white pine blister rust is the only known exotic disease which merits the application of this policy in these Parks.

Blister rust, a parasitic fungus (Cronartium ribicola), attacks the bark and living wood of five-needle pines such as sugar pine (Pinus lambertiana) and white pine (Pinus monticola) by forming "blisters" or "cankers" on branches and boles. These kill the trees by girdling. The pathogen propagates in a cyclical pattern. Spores spread from pines to the alternate host (Ribes spp. such as gooseberry and currant) in the spring and spread back to the pines in the fall. Spring spores, those which infect ribes, can travel several hundred miles. Fall spores, those which infect pines, generally travel only a few hundred feet horizontally and generally less than 20 feet vertically. Because of critical moisture requirements, both ribes and pines must be present within limited microclimatic conditions for the disease to occur in the southern Sierra Nevada.

Accidentally introduced to the west coast at Vancouver in 1910, blister rust spread with such alarming speed and devastation that in 1940 Congress passed the Lea Act. This legislation provides a source of funding and designates authority, ". . . for the purpose of controlling white-pine blister rust, by preventing the spread to, and eliminating white-pine blister rust from, all forest lands . . ." The Act gives the Secretary of Agriculture authority to use, and make available to other federal agencies, funds for blister rust control. The Lea Act does not authorize funds for monitoring the incidence or intensity of the disease outside areas designated for protection. The National Park Service receives funds by transfer from the U.S. Forest Service for blister rust control programs through this legislation. A biological evaluation of each proposed control program is performed by the U.S. Forest Service, designated technical advisor by the Secretary of Agriculture, before funding from this source is approved.

As to the situation in California National Parks, the U.S. Forest Service presently suggests two possible approaches for achieving control of this pathogen. One approach involves protecting indi-

vidual sugar pine trees by pruning rust from them. It is felt that if vigorous young pine are selected they can be brought to maturity by keeping them canker free. However, under this approach, any blister rust infection centers which occur would be allowed to intensify without any action to suppress or eradicate the pathogen. Many young pines could be killed, but those pruned would survive.

The second approach involves maintaining stands, not too large in size, rust free. Under this plan, infection centers should be discovered as soon as possible, which involves examining upland sites of protected stands every two - three years and stream sites annually. It also involves sanitation of infection centers by pruning all sugar pine branches within 20 feet of the ground in the immediate vicinity of a found center. A U.S. Forest Service comment relative to this approach is that it would be costly. They have also indicated that a rust free condition is a technically possible goal, and may be justified under some circumstances, especially if the area involved is not great. If centers are found before they become large, sanitation costs should be minimal.

There are seven known infection centers within these Parks. Most of the infection centers are relatively small, comprising only a few infected trees. Two centers are extremely large containing hundreds of trees.

An initial proposal was to effect control in all the centers. However, after discussion with U.S. Forest Service representatives, biological endorsement was limited to a pilot program to be initiated in the Garfield Grove. The success of this program motivated expansion of control areas to the largest and most impressive giant sequoia groves in which sugar pine also plays a dominant role in the vegetation. Approximately 21,000 acres of this ecosystem type are involved and included in eight control units. The management objective in these control units is to maintain and preserve these prime examples of this unique forest ecosystem free of rust. An incursion of this disease, if allowed years to intensify, could conceivably result in considerable modification of these areas.

Although control work is not now planned outside the units previously described, it is imperative to monitor the progress of known infection centers and to survey to discover new centers. Monitoring is important to determine how the pathogen will affect the forest ecosystem where it is found as its effects will influence future decisions as to the advisability and direction of

control actions. This program must be funded by Park Service funds. Transfer funds from the U.S. Forest Service under provisions of the Lea Act cannot be applied since control action is not now planned outside established control units and those "transfer funds" apply only to control and control related activities.

In addition to the monitoring activity described above, priority will be given in the Environmental Restoration Burning program to burn the areas of infection to return the area to a more natural condition as soon as possible. Such burning will remove the majority of young sugar pine in the class most susceptible to the disease as cankers seldom develop in branches higher than 20 feet above the ground surface. This will minimize the source of spore innoculum. Such burning will also reduce populations of Ribes spp. Although ribes are pioneer species and tend to become numerous after fires, the overstory (higher forest canopy) will still be intact and provide the necessary shade to suppress ribes as they are heliophytic.

Action Plan

1. Continue to pursue a rust free objective within the control units described above. This program will continue to be reviewed annually and, if it appears that infection centers are too numerous or too large, the rust free objective may be abandoned and the approach of protecting individual trees adopted or, the approach of taking no action may be considered appropriate.

2. Monitor the intensity and spread of blister rust in all known infection centers, and any which may develop, outside the designated control units.

3. Prescribe burn selected areas of infection to control the spread and intensification of the disease by lessening concentrations of intermediate host plants (Ribes spp.) and reducing the number of canker bearing and susceptible trees. The effects of fire by environment burning on blister rust will be monitored and researched.

4. Efforts made in conjunction with cooperating federal and state agencies to detect and control Gypsy moth (Porthetria dispar) a serious defoliator of hardwoods, will continue. This involves placement of attractant-coated funnel traps designed to capture all male moths in selected campgrounds.

FIRE MANAGEMENT AND CONTROL

Fire management programs include the use of fire both in prescribed burning and in its natural role with the primary objective of reestablishing and/or maintaining natural ecosystems.

Fire control programs involve the immediate attack and suppression of fires in vegetation to prevent damage to cultural resources or physical facilities.

FIRE MANAGEMENT

Natural fires, until the instigation of formal fire suppression activities, has been instrumental in producing and maintaining the plant communities representative of these Parks. If all natural fires could be allowed to burn, nature would indeed be playing its natural role. The primary objective of the fire management programs within Sequoia and Kings Canyon National Parks is to allow naturally occurring fire to play its primeval role as a determinator of ecosystems. This process has already begun in the High Elevation Fire Management Zone. Prescribed burning is not required as a prerequisite to such a program in this Zone since the effect of a more limiting climate has not resulted in the production of quantities of fuels found at lower elevations.

A secondary objective, pursued at the lower elevations, is to eliminate unnatural accumulations of dead and down vegetative debris and thickets of young trees which are filling in formerly open forest, so that naturally occurring fire may be allowed to effect its natural role. These accumulated fuels also increase the possibility of serious resource damage from wildfire. The use of prescribed fire is the main management tool available to reduce these fuels; however, some mechanical fuel reduction by cutting is in order in developed areas and along roads.

Until the mid-1960's forest fire control policies had been to find, attack and put out all fires in vegetation in the least possible time with minimum burned acreage. A number of disadvantages to this policy became apparent:

1. The value of the physical resources expended in suppression sometimes exceed the value of the natural resource involved.

2. The compounding problem of accumulating fuel loads was

essentially ignored and fires became increasingly difficult to keep small when weather conditions, primarily wind and high temperatures, were contributing. Fires larger than 300 acres now account for over 70 percent of all acres burned in the Rocky Mountain and Pacific States (U.S. Forest Service 1970).

3. Lightning fires are natural environmental factors. Suppressing them causes important changes in natural ecosystems, deflecting the direction of plant succession and effecting all associated fauna. The importance of fire in the maintenance of sequoia (Sequoiadendron giganteum) ecosystems has been especially well researched (Kilgore 1970, 1972; Hartesveldt 1964; Biswell 1961).

Transition from the traditional approach to fire control occurred in 1963 when the Leopold Report (Leopold et al. 1963) recommended restoring park forests to pre-European man conditions with emphasis on more openness. The Report indicated, "Much of the west slope (of the Sierra) is a dog-hair thicket of young pines, white fir, incense-cedar, and mature brush - a direct function of over-protection from natural ground fires. . . . A reasonable illusion of primitive America could be recreated, using the utmost in skill, judgment, and ecologic sensitivity." The Leopold Report summarized what had long been apparent to many professionals in fire control with extensive experience in fire behavior, scientists involved with research on wildfire and its effects on forest vegetation, and many others who, though not involved professionally in the management of natural resources, were nevertheless astute observers of nature's ways. The galvanic effect of the Leopold Report was evidenced by a change in National Park Service Policy (1965) relating to fire which states:

> "The presence or absence of natural fire within a given habitat is recognized as one of the ecological factors contributing to the perpetuation of plants and animals native to that habitat. 'Natural fires' are recognized as natural phenomena and may be allowed to run their course when such burning can be contained within predetermined fire management units and when such burning will contribute to the accomplishment of approved vegetation and/or wildlife management objectives."
>
> "Prescribed burning to achieve approved vegetation and/or wildlife management objectives may be employed as a substitute for natural fire."

In order to meet the objective of restoring and/or maintaining

the environment as naturally operating ecosystems, Sequoia and Kings Canyon National Parks have developed two fire management programs: (1) a zone generally above 8,000 or 9,000 feet elevation, including roughly 600,000 acres, where naturally occurring fires (i.e., lightning-caused) are allowed to run their course without suppression (Figure 2); and (2) environmental restoration burning (by prescription) in the generally lower elevation forests between approximately 4,500 feet and 7,000 feet elevation. A summary of conditions, research and policy behind the establishment of the above programs (Appendix 1), with their results through the 1971 fire season, was published by Kilgore and Briggs (1972).

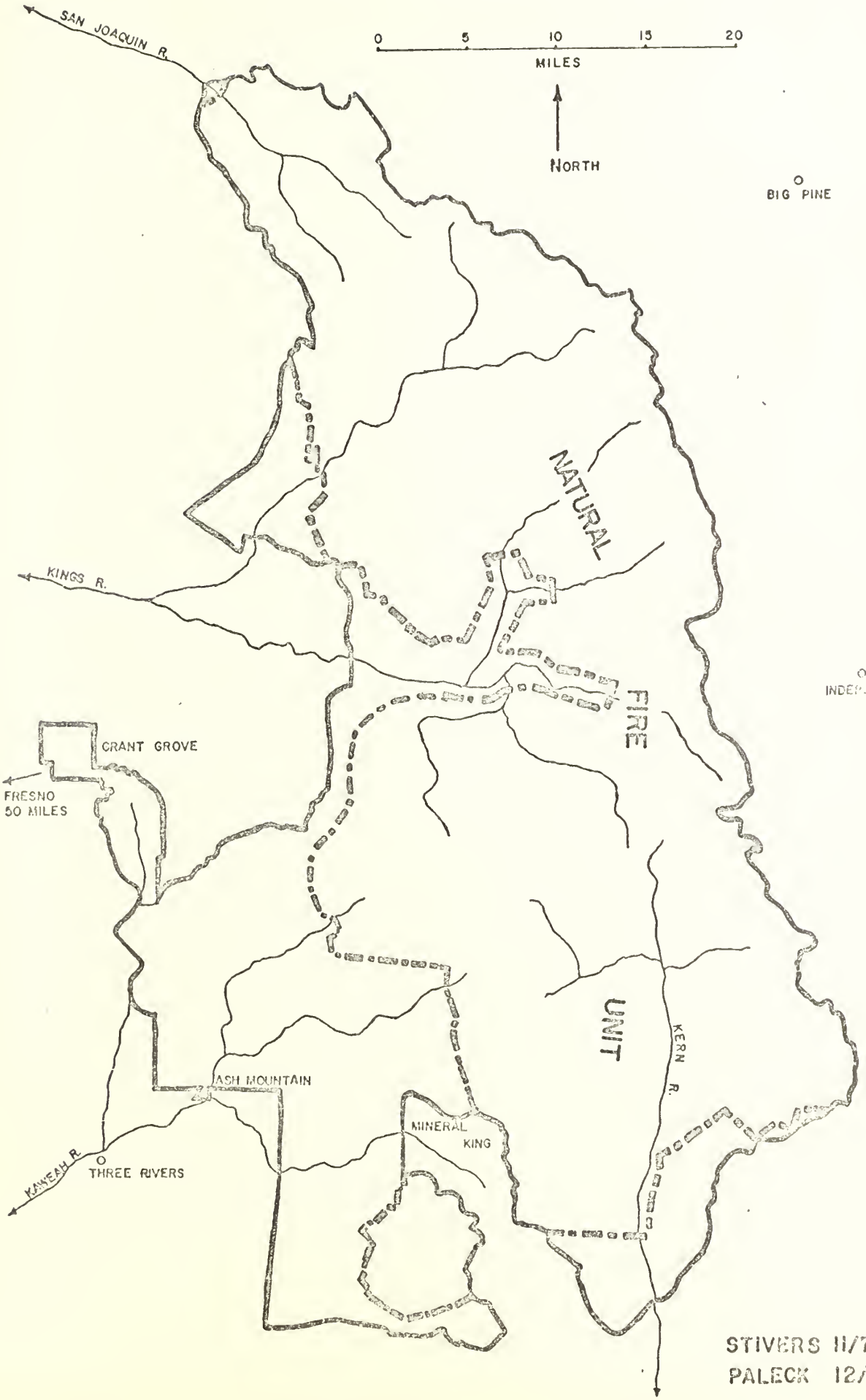
In 1968, the first resource management burning was done in the Redwood Mountain area. In 1969 a series of plots approximately 1,000' x 300' in size were burned along Redwood Mountain ridge from near the "saddle" to a point about one mile south. Burning continued in 1970, 1971, and 1972. No burning was done in 1973. Most burning was done in the fall. Techniques and prescriptions were improved with time. Initially all sequoias were individually protected with fire line, young tree thickets were cut and laid flat to avoid the possibility of crowning, sprinklers were set out to reinforce fire line and pumps and hose were used. The value of the resource and the pioneering in prescription burning warranted such precautions. Costs, about $200 per acre in 1969, have steadily decreased as techniques improved. Except for fire line, snag falling and similar preparatory work, little else is needed but suitable prescriptive conditions, a thorough plan to cover emergencies and sufficient manpower. These ingredients will allow the removal of litter, dead accumulated fuels of all sizes and thickets of young trees from the forest floor. Burning costs in 1972 were about $20 per acre. Regional reserve funds were used for prescription burning in 1972 and planned for use in 1974 (spring). No other funds have been provided for prescribed burning.

Upon completion of work in the Redwood Mountain sequoia grove, plans will be made to treat other groves in the same way. In addition to the sequoia groves, prescribed burning will be extended to the mixed conifer and fir zones with the same objectives that pertain to the sequoia groves. Research is needed in chaparral vegetation to determine the role of natural fire there.

Action Plan - Environmental Restoration Burning

Prior to burning a detailed plan is prepared. The plan is made and executed by qualified fire personnel. The Fire Boss will

FIGURE 2
NATURAL FIRE UNIT MAP



have at least a Division Boss Rating (red card), but a Class I or Class II Fire Boss or Plans Chief I rating is preferred.

A burning plan will contain the prescription applicable, will be reviewed by members of the Superintendent's staff and be approved in writing by the Superintendent before implementation. Objectives of the proposed burn are included, as are the inclusive dates during which burning may be conducted. The Superintendent will be continuously informed concerning the progress of burning operations, and any other unusual circumstances such as fire escaping from authorized burning units shall be reported to him as soon as possible. The plan will provide for sufficient men and equipment to manage the fire successfully and in addition will call for the training of individuals in the conduct of burning operations so as to increase the level of expertise within the Parks. The type of fire required to accomplish plan objectives will be included.

Atmospheric pollution by smoke is carefully considered in fire management programs. The degree to which smoke actually is a "pollutant" has been investigated by many and is currently being researched in depth by several agencies. A literature review (Hall 1972) indicates there is no evidence that smoke from the combustion of forest fuels causes permanent injury to human health. Obscured visibility does occur and may result in a temporary occlusion of vistas. Burning is done only during periods when smoke will be carried away from populated areas and over the Parks where it can be gradually dissipated. Normally prescriptions used result in fires burning hot enough to minimize smoke. Temperatures of about 1400°C result in near complete combustion of forest fuels. Such temperatures are not normally attainable or desirable in prescribed burning done in these Parks, but should be hot enough to minimize smoke production and develop a convection column to carry smoke high enough to be well dispersed.

The public and other land management agencies must be informed prior to burning and kept informed of the progress of burning and cooperation in the exchange of information is important. Observers from other agencies are encouraged during burning activities.

Action Plan - Natural Fire Program

In 1968, the Parks experimented with allowing lightning caused fires to burn naturally in the Middle Fork Drainage of the

Kings River within Kings Canyon National Park. In 1970, a Naturally Occurring High Elevation Fire Management Zone was established which included the Middle Fork Drainage (Kilgore and Briggs 1972). Expanded in 1971 and 1972, this zone currently includes nearly 71 percent of the area within these two Parks. Zone boundaries are set between the 8,000 and 9,000 foot elevation; however, fuel types, exposure, zone configuration, and other factors are also considered. Boundary changes must be based on precise, detailed evaluation of several factors including on the ground analysis of fuels, topography, and other factors influencing expected fire behavior; photogrammetric analysis; and relevancy of the addition to the existing unit to meet the objectives of the Natural Resources Management Plan. Recommendations for additions are normally made by the Resources Management Specialist in conjunction with the Fire Management Officer subject to approval by the Superintendent.

Naturally occurring fires within the Natural Fire Zone are continually monitored. Such fires are usually detected by Park reconnaissance aircraft. From the time of detection, a report is made through aerial, and if feasible, ground surveillance, for any day fire size increases significantly. The fire situation is continuously evaluated by members of the Park Wildfire Committee composed of wildland fire experts and Park administrators. The Committee, or a quorum thereof, may order a fire suppressed or limit its size, or may recommend other appropriate activity to keep the fire within the zone boundaries. Table 1 summarizes fires occurring in the High Elevation Fire Management Zone through 1973.

Whenever natural fires are burning, public news sources will be provided with all pertinent details. Other adjacent land management agencies will be informed on a regular basis of fires burning, including acreages.

Public safety is of utmost importance. There have been no problems involving public safety in the history of the program and this situation must be maintained. Examples of precautions to be taken are posting warnings on trails where natural fires are burning and providing information on the purpose and location of fires to all entering the back country. In extreme cases, areas might require closing for periods of time.

The effects of natural fires on vegetation, plant succession, erosion, water quality and other ecosystem elements will be monitored.

Table 1

Number of Lightning Fires in Naturally Occurring High Elevation Fire Management Zones, Sequoia and Kings Canyon National Parks, 1968-1973.

Size Class (acres)	1968	1969	1970	1971	1972	1973	Total Fires (By size class)
0. - 0.25	1	2	20	23	11	7	64
0.26- 9.	1	0	1	1	2	1	6
10. - 99.	0	0	2	0	2	0	4
100. -299.	0	0	0	1	1	0	2
300+	0	0	1	0	0	3*	4
Total acres	8.01	0.30	494.5	115.0	161.79	4,772.65	
Fires (by year)	2	2	24	25	16	11	80

*South Sentinel Fire - 2,486 acres

Moraine Creek Fire - 1,760 acres

Chagoopa Fire - 525 acres

Research will be performed to establish the role of natural fire in the chaparral vegetation zones (generally under 4,000 feet in elevation). This research should show how fire could be re-introduced to function as a natural element of the ecosystem.

FIRE CONTROL

Outside the High Elevation Fire Management Zone all fires, except prescribed fires, are attacked and suppressed as soon as possible.

All man caused fires, wherever they occur, are attacked and suppressed as soon as possible. In areas where natural fires are permitted to burn, suppression of man caused fires is required to avoid an unnatural imprint on the vegetation succession pattern. Otherwise, dynamic natural operating ecosystems will never be clearly understood or maintained.

No fire control action is taken without detailed consideration of the effect of the action on the ecosystem. The relative trade-offs between the objective of immediate suppression and possible resource damage resulting from suppression must be continually under evaluation in any given suppression action. As an example, a choice between the use of a crawler tractor and a hand line may involve contrasting losses from possible future erosion and long lasting scars on the landscape with larger acreages burned due to the increased required time to construct hand line.

The overall objective of fire suppression is to effect efficient, immediate action in a way that avoids or minimizes possible natural resource damage.

Action Plan

1. All fires in vegetation occurring outside the Naturally Occurring Fire Management Zone will be suppressed as rapidly and efficiently as possible. All man-caused fires within this management zone will be suppressed. Suppression action will be taken in a way that avoids or minimizes possible damage to the environment.

2. Fire control training will stress the importance of minimizing resource damage as a result of suppression action.

3. No fire will be abandoned until fire camps, helispots, fire line and adjacent areas are free of trash, supplies, equipment or any other type of unnatural material.

4. When fire suppression measures are taken, all stumps of felled trees will be flush cut to within six inches of the ground or as close as natural barriers, such as rocks by stumps, will permit. In addition, stumps will be treated with borax to prevent innoculation with Fomes annosus (see section on Native Insect and Disease Control), and all trees will be bucked to lay flat on the ground and limbed with all slash either burned or lopped and scattered. If the emergency prevents any or all of this action, it will be performed after the fire is controlled but before it is abandoned.

5. In emergency conditions, helispot construction is authorized. No helispots will be pre-constructed, i.e., in the back country, for possible future use. Construction usually damages Park resources where trees are felled. Falling green conifers often results in their invasion by forest insects with developing broods which emerge to attack surrounding standing trees. Where feasible, fires will be manned and serviced from naturally open helispots or those requiring a minimum of clearing. Officials in charge of the emergency must be able to justify helispot construction for reasons besides cost or convenience. Where trees are felled they must be treated as in 3 above.

6. All suppressed fires will be examined by a resource technician and a plan for rehabilitation, if necessary, prepared for the Superintendent. Rehabilitation will include any uncompleted action listed in 2 or 3 above, replacement of fencing designed to protect the area's resources and protection of fire lines and other disturbed areas from erosion. Water diversions will be constructed on disturbed areas as follows:

	Spacing (in feet)	
	Low	High
Percent of Slope	Erosion Hazard	Erosion Hazard
4-6	350	300
7-9	250	200
10-14	175	150
15-20	120	90
21-40	70	50
41-60	40	25

7. Aerial detection together with the establishment of the Naturally Occurring Fire Management Zone and occluded visibility in smog and haze have made Mitchell Peak, Cahoon Rock, and Ash Peak Lookouts unnecessary. The Lookouts, abandoned since 1968, will be removed. They are all remotely located except one and the road to it is no longer maintained. Their presence represents an unnatural intrusion in the otherwise wild Park environment.

LANDSCAPE MANAGEMENT

Landscape management, as it relates to natural resources management, takes basically two forms within these Parks: revegetation and vista clearing.

The objective of revegetation within developed areas is to approximate, as closely as possible, the vegetative scene which would have naturally existed had the physical works of man and associated human activities not occurred.

Revegetation is traditionally implemented at sites which have been subject to either new construction or the removal of old structures and facilities. In describing the role of landscape management Administrative Policies states:

> "When consistent with and not materially disruptive of the maintenance of natural ecological associations of the area, landscape management will be practiced to erase, ameliorate, or conceal the scars and visual impact of structures, facilities, and construction activities related thereto which impinge on the natural scene."

It also provides a means of artificially perpetuating and restoring the native vegetative complex within areas of continuing high use. Administrative Policies states that:

> "Management will minimize, give direction to, or control those changes in the native environment and scenic landscapes resulting from human influences on natural processes of ecological succession. Missing native life forms may be reestablished where practicable."

In recreation sites, modifying human influences such as excessive trampling, soil compaction, reduction or removal of natural ground cover, mechanical abuses, and the gradual thinning of mature overstory indirectly caused by these influences combine to upset natural regenerative processes and disrupt the natural scene. Revegetation serves to offset many of the visual effects of these influences.

The objective of vista clearing along roadways is to maintain and/or improve scenic vistas. A 1968 report entitled "Park Road Standards" stresses the importance of road design and construction techniques which heighten the quality of experience afforded the

Park motorist. That report states, "And, the design and location of the road should constantly encourage people to leave their automobiles to more thoroughly experience the Park . . . In forested terrain, clearing limits should be carefully controlled and selected cutting should be used to produce variation and indentation in the tree line." Administrative Policies supports the substance of this report and adds, "The road should, in fact, strive to maintain a continuing sense of intimacy with the countryside through which it is passing."

Action Plan

The action plan for landscape management consists of the following items:

1. Conduct studies within approximately 800 acres of developed recreational sites to establish the past vegetative mosaic and project future mosaic patterns should present use continue. As information becomes available, initiate revegetation programs using native vegetation from nearby areas.

2. Continue policy of spreading chipped slash material over denuded sites and areas exposed to excessive trampling to artificially restore ground litter and prevent erosion.

3. Continue judicious vista clearing along roadways following the standards for tree removal, slash disposal and stump treatment outlined under "Tree Hazard Abatement".

4. Prior to any construction activities, a plan for revegetation of the site will be made. The plan will be implemented after construction and before the next growing season.

TREE HAZARD ABATEMENT

Park Activity Standards states that trees and shrubs are to be maintained so that, "Areas of use are free of defective and/or potentially hazardous trees." In developed areas providing for visitors safety through the elimination of tree hazards is a legal responsibility. Various Solicitor General rulings have held that by operating campgrounds and other facilities the Park Service invites public use and as such it is the responsibility of the Service to insure public safety.

Tree hazard can be defined as the probability of mechanical failure of a tree or tree part with consequent injury or property loss. As long as any trees remain standing on forested developed sites these dangers can never be totally eliminated, for even relatively sound trees pose definable hazards.

But, since there exists both the objective to insure public safety and the objective to maintain areas in the most natural state practicable, a balance between too great a hazard and too unnatural an environment must be achieved.

Thus, it is an objective of natural resources management to establish and maintain a balance which abates tree hazard in areas of high use without destroying resource values.

Action Plan

The management plan relative to tree hazard abatement consists of continuing established programs listed below within approximately 6,000 acres of campgrounds, picnic areas, roadsides, parking areas, concessioner facilities, buildings, and residences.

1. Apply standard rating system (see Appendix 2) to assign priority removal values to tree and limb hazards within all development and road units. Priority assignments are reviewed within each unit at least once every five years and more frequently should unexpected conditions overbalance the hazard control level.

2. As fiscal resources permit, remove tree and limb hazards within development and road units according to their priority value following the guidelines listed below:

    a. All stumps will be flush cut. Stumps in campgrounds and high use areas will be cut so that no portion is above

ground level. Stumps along roadsides will be cut so that no portion is more than three inches above ground.

b. All cut stump surfaces of living trees will be treated with borax, which prevents innoculation by Fomes annosus. This pathogen may infect untreated stumps and is transferred to other trees through root systems in contact with one another. It can cause extensive damage to forests as it kills all infected trees.

c. All trees will be removed in a manner which minimizes damage to remaining vegetation.

d. All logs from felled trees will be removed to their natural breaks so that no visible saw cuts remain. Sections that are left must be laid on the ground and not hung up on rocks or other trees.

e. All limbs will be lopped and either scattered or chipped.

3. Accurate maps and records will be maintained to show:

a. Location of all tree and limb hazards assigned priority value, date of priority value assignment, individual assigning priority value, and tree condition which formed the basis for the hazard rating assigned.

b. Location of all tree and limb hazards removed and method of removal by work unit and work season.

HUMAN IMPACT ON SEQUOIA GROVES

The preservation and protection of the giant sequoia (*Sequoiadendron giganteum*) in its natural state was a primary purpose for the establishment of Sequoia and Kings Canyon National Parks. Restricted to 75 scattered groves on the western slope of the Sierra Nevada, the giant sequoia is the largest and one of the most impressive living organisms to be found anywhere in the world. First marvelled at by the early European visitors to the area (Engbeck 1973), the uniqueness of the giant sequoia ecosystem has been more recently detailed by Rundel (1971, 1972) and Hartesveldt, et al. (1970, in press). The uniqueness of this magnificent tree, together with its extremely limited distribution has led to the protection of most all of its present range in publicly owned preserves, the great majority of which now lie in these Parks (Griffin and Critchfield 1972).

The primary objective in managing the giant sequoia ecosystem involves the maintenance and protection of the trees in their natural habitat. All management actions must be based on the concept cf preserving the naturalness of the system, including, where necessary, the elimination of destructive human oriented activities.

Action Plan

1. An inventory of 9,739 acres of the larger and more accessible sequoia groves in the two Parks including a map location and brief description of each tree has been completed. A similar inventory of 4,805 acres of the remaining groves is currently under contract to be completed by 1975.

2. The ongoing environmental restoration burning program in the Redwood Mountain grove (see section on Fire Management and Control) will be continued and expanded to include other groves as time and funds permit.

3. The removal of all campgrounds from the sequoia groves in the two Parks has begun. The final restoration of these areas to their natural state has yet to be completed. The removal of all picnic grounds from the groves will be accomplished as soon as possible.

4. Recommendations for additional management actions which are necessary for the complete protection of the sequoia ecosystem

stem from findings that the construction of such amenities as roads, trails, sewer lines and buildings are detrimental to the condition of the system (Hartesveldt 1963). In the light of these findings, it is now considered necessary to remove all visitor and concession facilities out of the sequoia groves of the Giant Forest and Grant Grove areas. Except for selected interpretive aids, these areas should remain free from developments. This concept should be paramount in consideration of future development plans within the sequoia ecosystem. Studies are now underway to evaluate alternatives for implementing such concepts in the Giant Forest and Grant Grove areas of the Parks.

5. Specific actions needed to protect or restore the groves have been recommended by Hartesveldt (1963). These include further restriction of foot travel to established paths through the construction of rail fences and additional warning signs. The construction of new trails further from the bases of the larger trees and including elevated walkways in areas where they cross root systems in proximity to the trees are also called for. It is further recommended that, in those areas in which trampling by Park visitors has been severe, steps should be taken to mechanically loosen the soil and then protect it against further compaction. Where erosion has been severe, native top soil will be added. In addition, where future construction is necessary, efforts will be taken to avoid severe root cutting, to limit the root system under pavement to less than 25 percent for any given tree. The sooner such actions are taken, the surer we can be that the giant sequoia ecosystem will be protected in its natural state. At this time, a study is needed to draw up a plan for implementation of these basic recommendations.

6. Ongoing research efforts by Hartesveldt and co-workers on the impact of human oriented disturbances on the sequoia groves have provided background information and justification for many of these needed management actions. These investigations, as well as those under the leadership of Dr. David Wood of the University of California on the relation of carpenter ants (Camponotus modoc), human use levels, and structural failure in the sequoia will be continued and are expected to provide additional recommendations for management actions in the coming years.

WILDLIFE

Sequoia and Kings Canyon National Parks support a diversity of wildlife throughout their various ecosystems. Protection and perpetuation of these populations in their native state and minimizing conflicts with visitors and residents are the primary objectives in wildlife management for these Parks. Wildlife programs in these Parks are guided by Administrative Policies where it states:

"Wildlife Populations

Wildlife populations will be controlled when necessary to maintain the health of the species, the native environment, and the scenic landscape, and to safeguard public health and safety. Ungulate populations will be maintained at the level that the range will carry in good health and without impairment to the soil, the vegetation, or to habitats of the several species in an area.

Wildlife Management Program

Insofar as possible, control through natural predation will be encouraged.

Public hunting outside of the area is recognized as the next most desirable means of controlling wildlife populations. Cooperative studies and management plans with States and other Federal agencies are to be continued to facilitate public hunting outside of the areas, especially through extended special seasons established by the States for public hunting outside the areas.

Other measures as necessary, shall be undertaken as follows: (1) Live-trapping in the areas for transplanting elsewhere; (2) Providing research specimens for National Park Service and cooperating scientists; and (3) Direct reduction by National Park Service personnel. It is recognized that it may be necessary, on occasion, to carry on each phase of this program simultaneously. The National Park Service will adjust the use of these control methods (except natural predation) to meet varying weather and other relevant conditions, giving highest priority to the opportunities for public hunting outside the areas and live-trapping in the areas for transplanting elsewhere."

Patterns of visitor, administrative and recreational use and attendant developments have caused changes in habits and distribution of a number of native wildlife species. Many of these conflicts are serious problems, even though a small portion of the total population is involved. In some cases entire populations are affected. Most notably, deer populations are adversely affected by elimination of fire. Fire rejuvenates vegetation upon which deer are dependent.

Black bears (Ursus americanus) are found throughout these Parks in abundance and where they frequent developed areas their management becomes necessary to insure that they may lead natural lives with minimum interference by humans. In addition native bear populations impinge on human activities and cause problems, which center around storage of human food and wastes therefrom. This type of problem must be countered by modification of existing solid waste handling procedures and through educating and effecting better food storage by employees and visitors. As anticipated studies are conducted, new light may be shed on unknown factors, such as the ability of bears to adapt after relocation, and what differences exist between bears subsisting on natural food compared to bears relying on human sources. Future management procedures will be guided by these findings.

Mule deer (Odocoileus hemionus) populations, are subject to wide cyclic fluctuations, depending upon such factors as climate, and available forage and perhaps others. The currently low number of deer in these Parks is less than 50 percent of the level 20 years ago. During the 10 year period starting with 1955, an average of 92 excess deer were taken each year by rangers in these Parks by direct reduction (no reduction in 1963 due to local protest). In the six year period beginning with 1964, an average of 15 deer were taken each year in direct reduction. These latter reductions removed animals unnaturally concentrated by the availability of human food. These deer became diseased, dangerous, and placed undue stress on available natural vegetation. Since that time statewide reports of declining deer numbers have been of general concern and thus no reductions have been attempted in these Parks. Such abrupt changes in management philosophy exemplify the lack of complete understanding of the status of deer populations because resource technicians are not available to monitor population and browse conditions.

Fire suppression activities in the past years (see Fire Management and Control) altered vegetative communities, limiting available forage and reducing deer range. Modern concepts of the role of

fire in developing and maintaining vegetative mosaics and their availability as browse material are beginning to reverse the fire suppression policy. During the next few years deer range should be examined for the effects of fire as fire is returned to its natural role.

Raccoons (Procyon lotor) are native inhabitants in the foothill oak woodland. This species is very successful in residential areas where food from garbage cans is readily available. Raccoons present a safety hazard to humans, when animals habituated by human contact bite or scratch curious onlookers. Unsanitary conditions present a health hazard where populations become dense and many animals gather in crawl spaces under dwellings to produce objectionable odor and noise. Infrequent live-trapping and relocation attempts have reduced populations at times when acute problems were identified.

Woodrats (Neotoma cinerea) enter older dwellings in residential areas where, by nest-building and related activities, they damage structures and present a health hazard with their accompanying parasitic fleas, lice and kissing bugs (Triatoma protracta). The parasitic insects are themselves vectors of disease organisms which infect man. Accumulated litter and chewed electrical insulation can be a fire hazard. These conditions are found in older buildings which now do not meet modern standards. To date management actions have been limited to use of approved poison bait and trapping.

In past years, ground squirrels (Citellus beecheyi) have been reduced in the Potwisha Campground area of Sequoia National Park. This was done to combat high population buildups, which are indicative of potential outbreaks of plague. State agencies who were carrying out reduction in several nearby areas contributed to the effort in these Parks. Individual animals suspected of plague infection have been collected and sent for examination to cooperating County, State, and Federal agencies. To date no positive signs of this disease have been found.

See the sections which follow entitled "Rare and Endangered Wildlife" and "Exotic Mammals and Birds" for other common Park wildlife species known to be an important part of the wildlife resource. Future research and inventory should identify needed management actions.

Action Plan

1. Bears

A. Waste Disposal - All solid waste containers will be made bear-proof before the end of calendar year 1975. Until bear-proof containers are installed, garbage collection will be scheduled late enough in the day to minimize food available in cans overnight.

B. Bear Management - When action is required in a bear incident the bear may be trapped or placed in a mobile trap and relocated or the dangerous bear may be dispatched with an appropriate weapon. A summary of management actions follows:

(1) Bears exhibiting the following behavior will behavior will be observed and each case judged individually.

a. Bears that on rare occasions forage in non-bear-proof solid waste containers or take unattended food chests or other food are merely following natural behavior and cannot be classed as problem animals. If frequency of such behavior is verified such bears should be live-trapped with a culvert trap and relocated to remote areas of these Parks.

b. Bears that walk through campgrounds and other developed areas without threatening people, begging, taking food from occupied sites, or destroying property constitute a potential problem. If the potential pattern develops into a threat of human safety or property damage the bear should be live trapped and relocated.

(2) Bears exhibiting the following behavior will be trapped and released at some remote site.

a. Bears that enter occupied campgrounds and campsites and search for and/or take food even though people take action such as shouting, beating pots, and throwing articles.

b. Bears that regularly break windows in vehicles

and break into closed trailers, campers, and buildings.

When trapping is unsuccessful the bear should be taken with the Cap-Chur gun and the immobilized animal placed manually in the trap for subsequent transfer and release elsewhere.

(3) Bears whose behavior falls in one of the following categories will be considered for destruction.

a. Bears that attack and/or injure people without provocation.

b. Bears that growl at, rush, chase or otherwise threaten people without provocation.

c. Bears whose behavior is described above in Part (2) b, and return to developed areas to resume their destructive habits (provided relocation was of sufficient distance to challenge the bears' return capability).

(4) When female bears with cubs are trapped and the cubs remain outside the trap.

a. Attempts should be made to take the cub or cubs with the Cap-Chur gun and all bears relocated.

b. If the parent bear must be destroyed, the ranger in charge will decide if the cubs are old enough to wean. If they are old enough they should be relocated. If they are too young:

(a) The California Department of Fish and Game should be contacted for an outlet.

(b) The cubs should be destroyed and disposed of by approved methods.

C. Education and Information - Interpretive messages will alert visitors to the necessity for proper food storage to avoid bear problems. Employee orientation programs will inform workers and Park residents of potential problems and how to avoid them. Bear reports will be routed to the Fish and Wildlife Specialist. Damage will be reported through the appropriate channels to the Chief Ranger's Office.

2. Deer - A complete study of deer habitat and herds will be carried out to help guide future management actions. A few selected animals from each herd marked with paint, collars, ear tags or electronic devices will be used to determine migration routes between winter and summer ranges. If population measurements clearly indicate that the carrying capacity of the range is exceeded, direct reduction will be accomplished by Parks personnel after necessary liaison with State and local agencies. Within limitations of funding and other management considerations, restoration of natural deer habitat by prescribed burning, will be carried out. During the next few years deer range will be examined for the effects of fire as fire is returned to its natural role.

3. Raccoons - Control will rely entirely on trapping with live traps and relocation to areas where the animals can be assimilated into the natural wildlife community. Areas for relocation should be distant enough as determined by marked animals to preclude easy return to the original home range. This action will be taken when animals congregate in buildings, causing odor and damaging property. Individual animals threatening human health and safety by biting or scratching will also be removed and relocated. Reports of raccoons merely emptying garbage cans will not be a valid criterion for removal of offending raccoons from residential sites, campgrounds, or other developed areas.

4. Woodrats - Woodrats will be reduced when they are present in dwellings. Treatment of individual dwellings will be carried out with an approved pesticide. As funds become available, dwellings will be upgraded to a standard prohibiting access of woodrats.

5. Ground Squirrels - A method of population census will be developed to show annual population differences in a given area and comparison between developed (i.e., campground) areas and natural populations in undeveloped areas of the same habitat. When reduction is deemed necessary by reason of an identified problem as the presence of plague, in developed areas, burrows will be treated with an approved rodenticide and insecticide. Treatment should insure that contact will be limited to target pests.

RARE AND ENDANGERED WILDLIFE

While these Parks are dedicated to the protection and perpetuation of all native indigenous wildlife resources, those species classified by the U.S. Fish and Wildlife Service as "rare" or "endangered" or species recommended by State authorities for this designation merit special attention. Administrative Policies states:

> "In no case will harassment of rare and endangered species be permitted, and undue disturbance thereof must be avoided."

Special attention includes such activities as concerted efforts to document all sighting of subject species by use of field wildlife observation cards; special studies to determine population densities, locations and migratory patterns; and management activities which are directed at minimizing human disturbances where they are determined to be detrimental.

The rare California bighorn sheep (Ovis canadensis californiana), appears to be declining in numbers. Increased human activity within its range is thought to be a factor adversely affecting the species. Management has been limited to restricting human use on winter range. Winter range for these animals lies wholly on U.S. Forest Service administered land east of Park boundaries (see Figure 3). California bighorn sheep zoological areas established by the U.S. Forest Service on winter range limit travel to those who obtain a permit from district offices. Commencing in 1973, officials from these Parks recommended to personnel of the U.S. Forest Service limits of 25 persons per day entering from the east side over Baxter, Sawmill and Shepherd Passes in Sequoia and Kings Canyon National Parks. These limits were not reached in the summer of 1973. To date no effort has been made to restrict travel on summer range areas within these Parks. Summer range for bighorn sheep is thought to lie almost entirely on National Park Service lands with the largest population in the Mount Baxter and Mount Williamson areas (see Figure 4).

The wolverine (Gulo luscus) and the fisher (Martes pennanti), both formerly ranged over the entire Sierra. In recent years sightings within these Parks have become increasingly infrequent. Their secretive habits and remote location of habitats make observations of both species difficult. In 1933 only 15 wolverines were reported to exist in California. Most numerous sightings of recent years indicate that they may be increasing. Sight records for these Parks

FIGURE 3
BIGHORN SHEEP WINTER RANGE

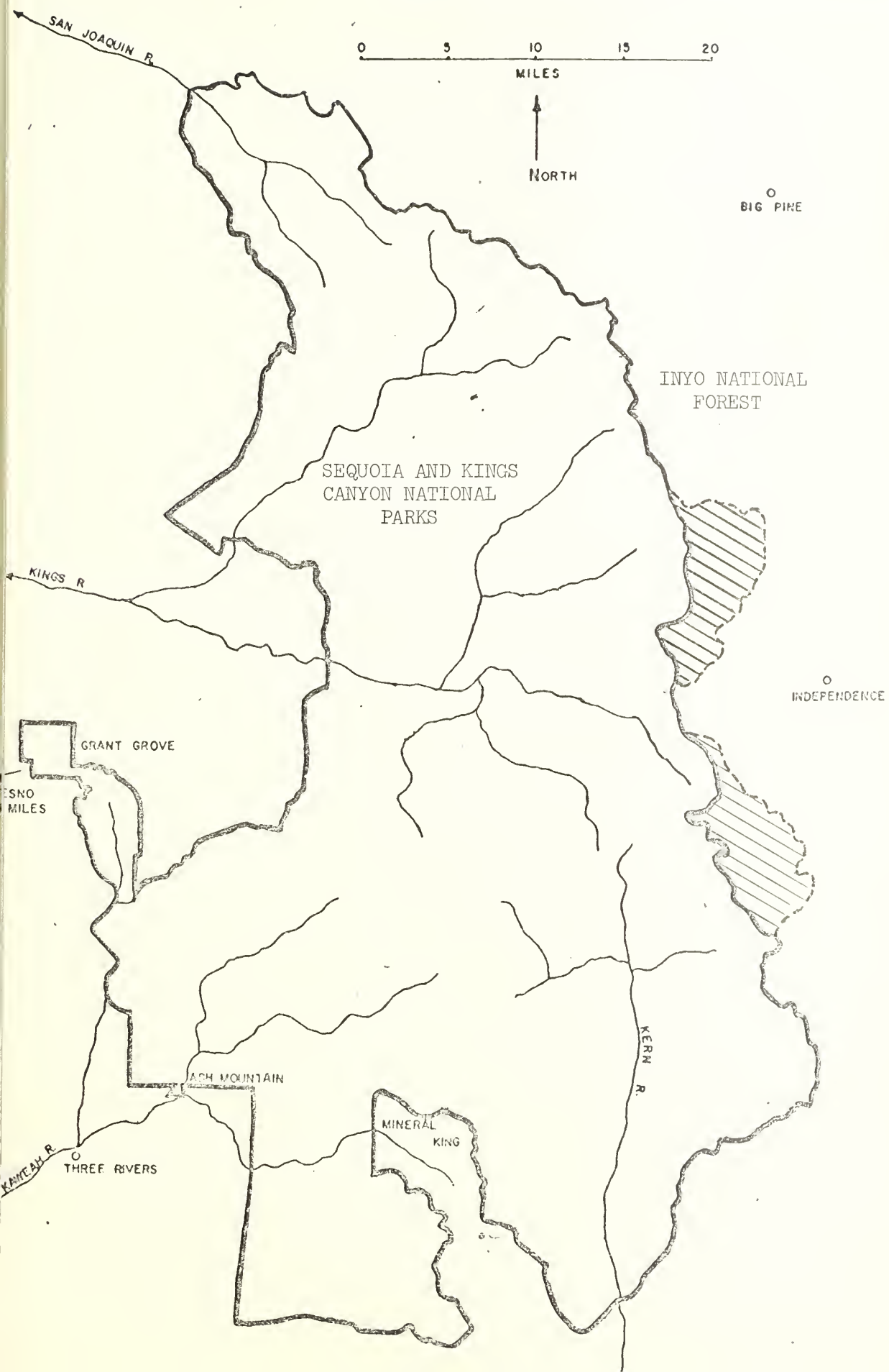
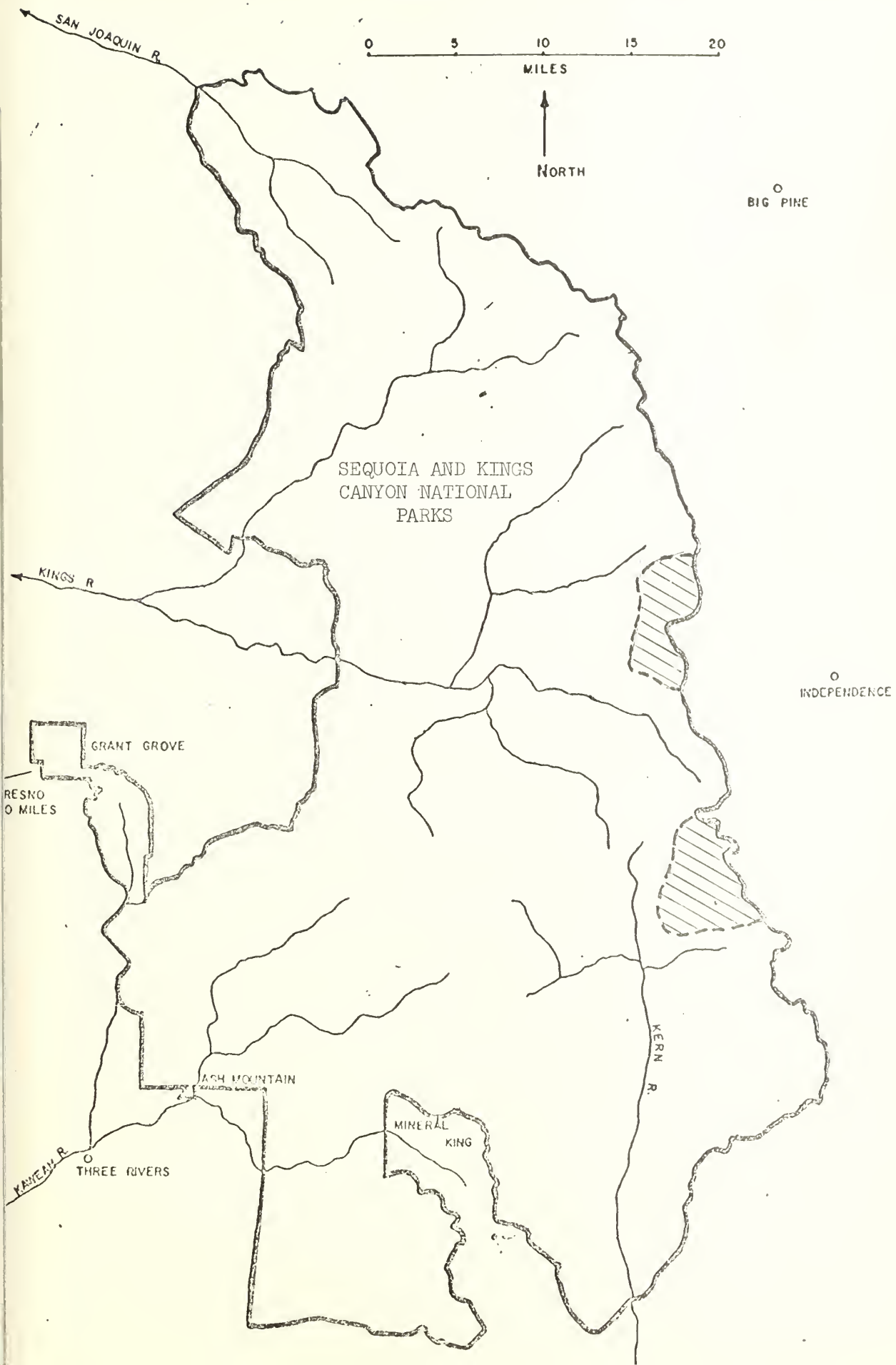


FIGURE 1

BIGHORN SHEEP SUMMER RANGE



on fishers average one per year and present indications are that the species is at a stable level.

Preliminary studies are underway on the mountain lion (Felis concolor) and spotted owl (Strix occidentalis). These species as well as the California condor (Gymnogyps californianus) will be given more attention as their status becomes more clearly defined.

Action Plan

1. Bighorn Sheep - Starting in 1975 it is proposed that the summer range areas will be temporarily closed while studies are conducted to determine the impact of human activities on sheep populations. These studies will be oriented toward determining what factors are causing the present decline in numbers. Information will be gathered on the impact of human activities on sheep behavior. In addition, monitoring of population numbers, location of herds, impact on the range and condition of the range will be conducted in order to guide future management decisions.

2. Wolverine and Fisher - With the recent increased emphasis on documented sight records for all species and the additional impetus given by a State survey of fur-bearers, additional records of these rare species will give a clearer picture of their status.

3. Cooperation will continue with State agencies on evaluating the current status of the mountain lion and the spotted owl.

4. Additional studies are needed on ring-tailed cat, golden eagle, pine martin and mountain beaver, considered to be rare, endangered, or threatened, with the purpose of providing recommendations for future management activities. Importance of the proper use of wildlife observation cards will be stressed in employee training sessions.

5. Studies will be conducted on the ecological role of two extinct species, the grizzly bear (Ursus horribilis) and the gray wolf (Canis lupus). Consideration will be given to current utilization of the ecological role of these extinct species as well as the feasibility and desirability of reestablishing them in these Parks.

EXOTIC MAMMALS AND BIRDS

A number of non-native mammals and birds can be found in these Parks and, to conform with established guidelines, should be eliminated. Administrative Policies states, "Non-native species may not be introduced into natural areas. Where they have become established or threaten invasion of a natural area, an appropriate management plan should be developed to control and eradicate them where feasible."

An exotic beaver (Castor canadensis) was introduced as a fur bearer into U.S. Forest Service lands adjacent to Sequoia National Park in the 1930's. In subsequent years, this beaver extended its range into the Kern Canyon portion of the Park (Figure 5). Recently, the animal has had a significant impact on the area through such activities as cutting of trees, building of dams, and subsequent flooding of meadows. In past years, such control techniques as shooting, blasting and burning of dams, and trapping have been attempted. Trapping has been determined to be most effective, and in 1970 and 1971, a trapping program, in conjunction with the Bureau of Sport Fisheries and Wildlife, was found to be especially effective. These control activities have attempted to maintain the population at a low enough level to minimize disturbance while at the same time counteracting it with soil and moisture conservation and restoration activities. Despite cooperative efforts between the National Park Service, the U.S. Forest Service, the Bureau of Sport Fisheries and Wildlife, and the California Department of Fish and Game, total elimination of the beaver is now considered impractical. It is very difficult to reduce the population below a certain threshold level and, even if this were accomplished, it is felt the beaver would always be able to return from the populations now existing in adjacent Forest Service lands.

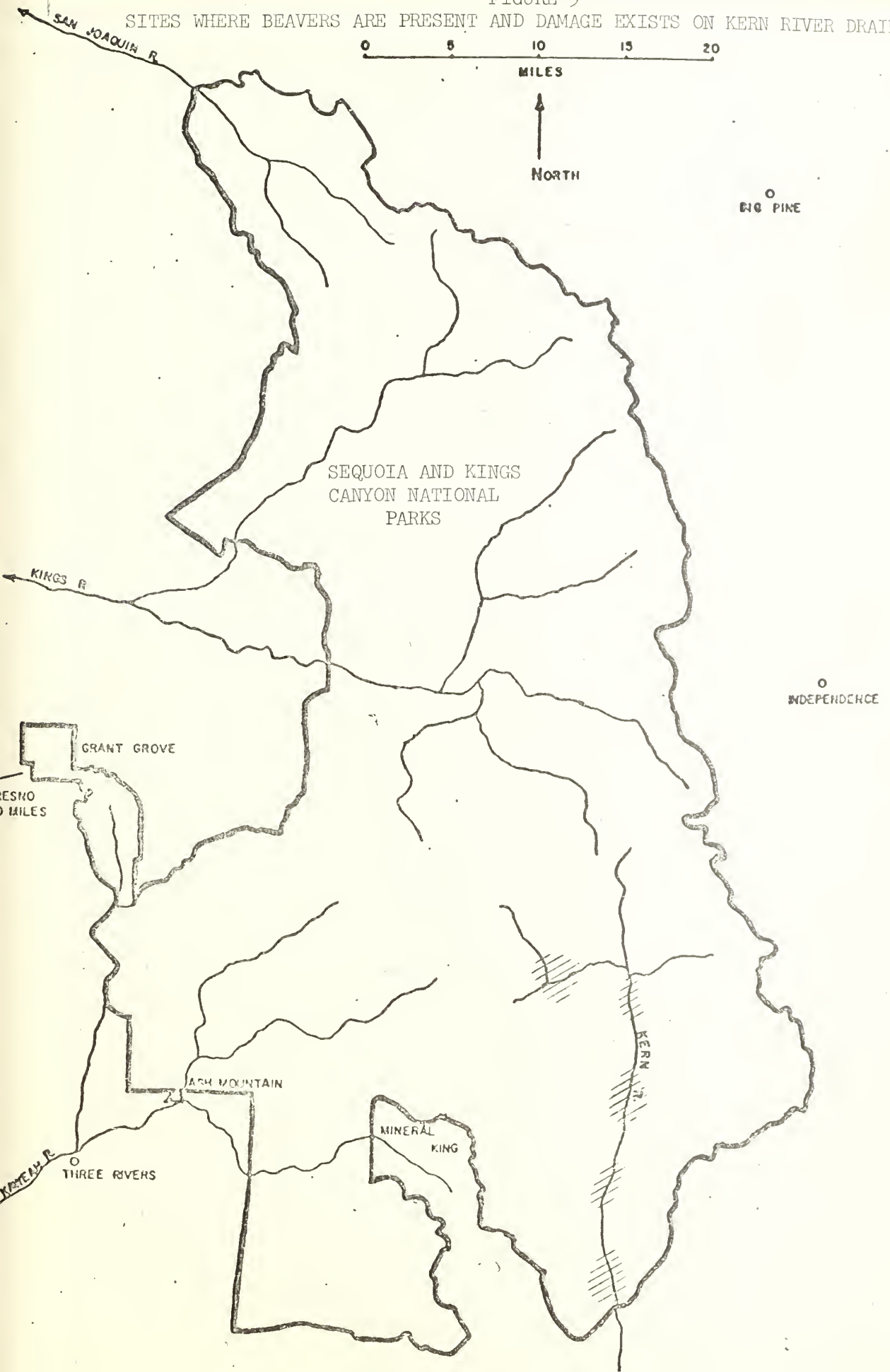
Populations of other species of exotic mammals and birds (including wild turkey, chukar, and starling) have been found in these Parks. Attention should be given to obtaining information on the current distribution and status of such species, including their ability to maintain a self-sustaining population.

Action Plan

1. Management activities directed at the beaver in the Kern Canyon must be continued at an increased level. Control activities will aim at maintaining beaver populations at or below a level considered tolerable with the natural resources. This is currently estimated

FIGURE 5

SITES WHERE BEAVERS ARE PRESENT AND DAMAGE EXISTS ON KERN RIVER DRAINAGE



at a total of approximately 12 breeding pair. This will be accomplished by trapping whenever the populations rise above this level. Additional action such as prescribed burning will be used to keep the river channel clear of logs and other debris. An evaluation of current and past impact of the beaver on the natural habitat, as well as continuing evaluation of the control actions are programed.

2. An inventory of the distribution and ecological impact of all other species of exotic birds and mammals as they are discovered in the Parks will be conducted. Recommendations will be made regarding possible reduction and elimination of these species.

3. Existing regulations regarding the confinement of visitor pets in high use areas and the prohibition of pets in backcountry areas will continue to be stringently enforced.

FISHERY MANAGEMENT

The primary long range objective of fishery management in these Parks is to preserve, restore and maintain endemic species and native aquatic habitats wherever possible. Administrative Policies states that "Fishing is an appropriate use and will be permitted under applicable rules and regulations." It is further stated in Administrative Policies that "Sport fishing is encouraged in natural areas when consistent with the restoration and perpetuation of the natural aquatic environments and the natural aquatic life."

Before European man entered the scene it is likely that most of the lakes in the high country were barren. Due to the glacial origin of the canyons the lowest waterfalls in hanging canyons were natural barriers prohibiting upstream migration.

A few barren lakes still maintain their pristine condition and some other lakes, too shallow to resist freezing are subject to winter kill.

Random stocking by fishermen and early efforts by the California Department of Fish and Game were responsible for introduction of exotic species, hybridization and spread of fish to waters which were originally devoid of fish. For the past 50 years it has been Park practice to stock selected lakes as needed to maintain angling potential.

Because angling is popular and large numbers of visitors frequent the lower Middle Fork of the Kaweah River, stocking of rainbow trout has been carried on in the 4 1/2 miles of stream from which water is diverted for electrical generation. Without this program, native rainbow trout populations are lowered and the restricted habitat becomes partially occupied by endemic suckers.

Action Plan

1. A basic inventory of Park waters will be conducted to determine the species present and the probability of survival if left on a self-sustaining basis.

2. Where waters have no history of stocking or where stocking has been discontinued for several years, and formerly established populations of fish are non-existent, or where winter kill occurs, waters are to be maintained in a barren state. Other lakes will be stocked as the need arises.

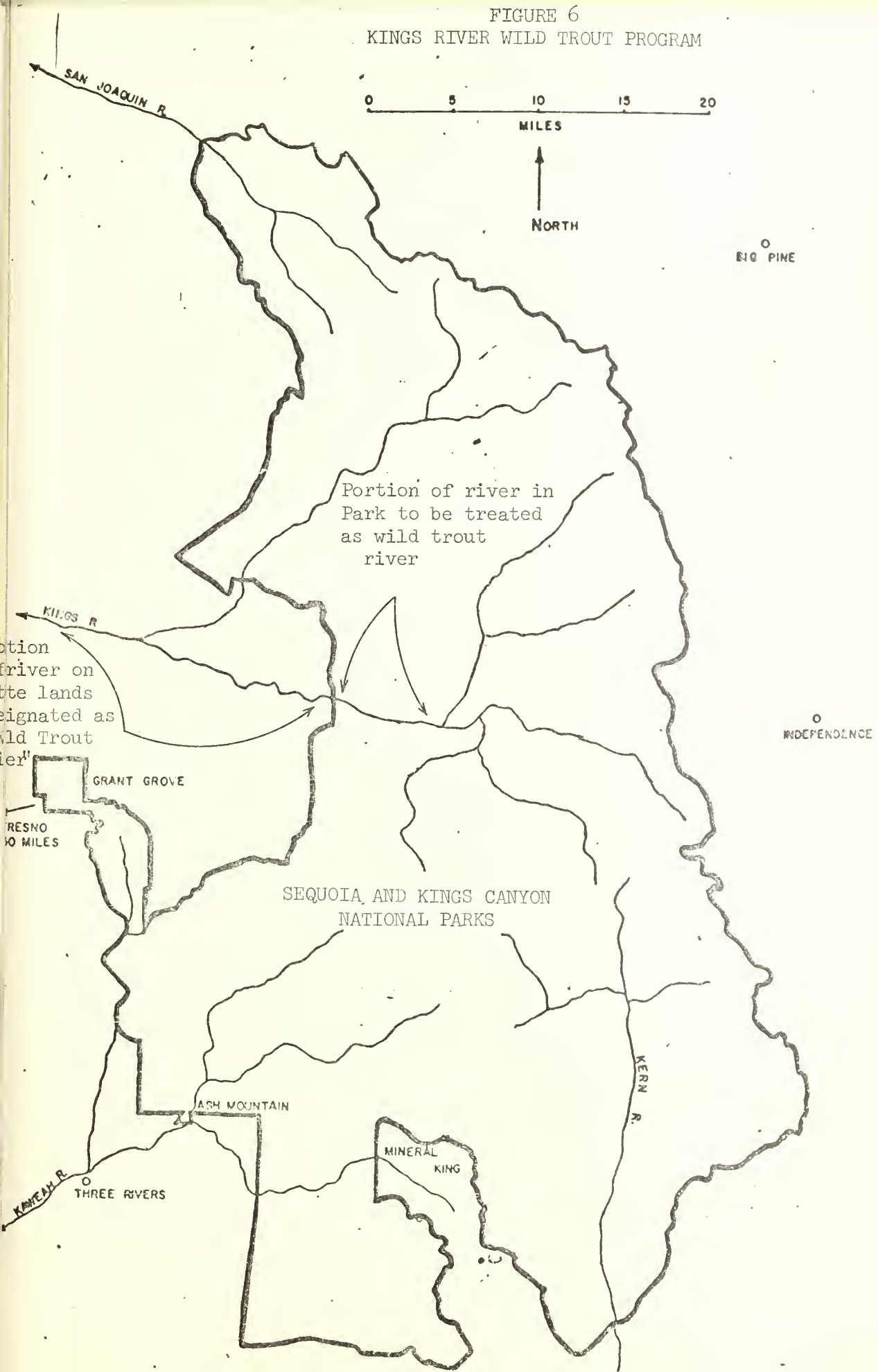
3. In waters where excessive visitor use has led to, or threatens to lead to deterioration of the environment, elimination of fish planting will be considered if backcountry visitor controls and fishery management and controls are not adequate.

4. Diversion of the Middle Fork of the Kaweah River water by the Southern California Edison Company (see section on Kaweah River Diversion Practices) has resulted in loss of aquatic habitat. Habitat modification resulting from diversion coupled with angling pressure on trout has favored large populations of suckers. Until the diversion is eliminated, populations of native trout will be augmented with stocked hatchery rainbow trout.

5. A five year study program began in 1973 in connection with designation of the Kings River as a "Wild Trout River". Seven miles of the South Fork of the Kings River in Kings Canyon National Park (Figure 6) is under special surveillance by the California State Department of Fish and Game. Under this new program no stocking will be done and observations will be made to determine whether natural reproduction can maintain trout populations at a level sufficient to withstand fishing pressure. These Parks are cooperating with the study. As regulations are adopted for that portion of the Kings River outside the Park, similar regulations will be considered for Park waters.

6. A short section of Soda Springs Creek in the Kern River watershed contains perhaps the last surviving genetically pure individuals of a subspecies of golden trout (Salmo aquabonita). In cooperation with the California Department of Fish and Game, U.S. Forest Service, the University of California, Davis, studies are underway to ascertain the genetic integrity of this population. A special closure prohibits fishing in this stream which is isolated from other fish populations by natural physical barriers. Future management decisions will be based on the outcome of present studies.

FIGURE 6
KINGS RIVER WILD TROUT PROGRAM



MEADOW RESTORATION, MAINTENANCE AND GRAZING

The management objectives and operational guidelines relative to the restoration and perpetuation of meadow ecosystems are referred to in Administrative Policies which states that the resource management task embraces, "The application of ecological management techniques to neutralize the unnatural influences of man, thus permitting the natural environment to be maintained essentially by nature." Specifically, policy as to grazing is, "Grazing of domestic livestock in natural areas is permitted only where it is sanctioned by law, is incidental to visitor use, or is desirable to preserve and interpret significant historical resources of the area."; and, "Support of Service or concessioner pack-and-saddle stock by the use of forage in a natural area shall be limited to locations where dry feeding is clearly impractical."

Extensive grazing by cattle, sheep and pack stock in the past severely upset natural ecological relationships within meadow environments and set in motion erosive processes of such magnitude that some areas continue to require active efforts to neutralize their effects. In some areas, trails were located directly through fragile meadow vegetation and sod. Continued soil compaction, the cutting, abrasion, and gouging by sharp hooves, and erosion have created multiple ditches up to 24 inches deep where trails were, or are now located. In some areas, camping has occurred in meadows and campfires have burned through the meadow sod, exposing erosive soils. The management objective regarding these problems is to apply sound principles and techniques of soil and moisture conservation to reverse erosive processes and eradicate unnatural scars as completely as feasible so that natural environmental factors can once again dictate the condition and development of meadow ecosystems.

One permit for the grazing of cattle remains in effect within the Roaring River Drainage of Kings Canyon National Park. The permit is life tenure in character, granted as a continuation of a permit held on part of Sequoia National Forest lands which were incorporated into Kings Canyon National Park when it was established in 1940. The range is subject to close Park control to avoid resource deterioration. The permit is non-transferable and will eventually expire.

Pack and saddle stock grazing is permitted incidental to visitor and administrative use. Such use is subject to certain restrictions and closures designed to protect resources. Current restric-

tions are based on subjective judgment rather than actual carrying capacities and are not regularly reviewed in the field for applicability. Appendix 3 includes current grazing controls and closures.

A number of drift fences exist throughout the Parks. Fences exist to prevent overuse and deterioration of Park resources. In some cases, drift fences incidentally serve to prevent stock from moving long distances. No fences are permitted which hold stock in small limited areas except for six administrative pastures where stock is temporarily held to be ready for use in connection with the administration of these Parks. Fenced pastures for ranger use are found as follows: two at the Roaring River Station; one at the Hockett Meadow Station; two at the Kern Station; and, at Horse Corral Meadow, one used from time to time by soil and moisture conservation and trail crew packers.

A number of meadows are encroached by lodgepole pine. In the past, lodgepole pine were removed from certain meadows designated to be maintained for scenic considerations. In some areas lodgepole is killed by snow avalanches and other natural causes. The ecology of pine encroachment has been studied and is not completely understood. Specific information may be available upon submission of a "Mountain Meadow Management" publication required of the University of California (Dr. Paul Zinke) summarizing studies done in Rock Creek Meadows, Sequoia National Park. No major lodgepole removal has been accomplished for about 10 years reflecting the referred to lack of information.

Several studies have been conducted to assess the condition of meadow ecosystems, identify impacted areas, recommend management actions and evaluate control efforts. These studies include: Special Report on Range Management and Wildlife Protection in Kings Canyon National Park (unpublished N.P.S. report, 1941), Tourist Damage to Mountain Meadows in Sequoia-Kings Canyon National Parks, 1935 to 1948 a Review with Recommendations (unpublished N.P.S. report, 1948), both by Lowell Sumner, and A Report on the Status Changes and Ecology of Back Country Meadows in Sequoia and Kings Canyon National Parks (unpublished N.P.S. report, 1959). An updating of Sharsmith's 1959 meadow survey is presently being conducted by Steve DeBenedetti of California State University, Humboldt.

Certain areas within Sequoia and Kings Canyon National Parks have been subject to trespass cattle grazing for many years. This has been recently reduced in several of those areas through fence construction and land acquisition. One area of cattle trespass was

along the Park line south of Shepherd Peak. This source was eliminated in 1972 when trail crews constructed a fence to protect the area as it is utilized at times by Park pack and saddle stock (primarily after they are brought into the Park in spring and before they are utilized and likewise in the fall after they come out of the mountains and before removal to winter pasture).

Two areas are presently subject to cattle trespass. One is along the Park boundary in the vicinity of Milk Ranch Lookout. Although Park vegetation is little affected, efforts are presently being made to determine the Park boundary and require the adjacent landowner to fence his private property and that of his Bureau of Land Management lease to prevent trespass. The other area involves an inholding in the Cahoon Meadow area near Cahoon Peak. Grazing overuse of Cahoon Meadow has devastated its environment. Twenty foot deep erosion trenches course the length of the meadow. The water table has dropped vastly and large portions of the meadow are drying up. Due to vagaries in the original survey of the area, the exact location of the 160 acre inholding is not known. If the main bottom meadow is actually included in the private land, only minor cattle trespass along the narrow "stringer" meadows entering the bottom meadow is involved. However, if the survey configuration of the private inholding does not include the bottom meadows, primarily Cahoon Meadow, and that meadow is determined to be federal land, immediate rehabilitation action will be required.

For the past three years Cahoon Meadow has been monitored to determine its condition and to identify possible erosion effects on downstream Park aquatic resources.

Action Plan

1. Restoration of natural soil, vegetation and water relationships in the Roaring River Drainage which have been altered by past cattle grazing will continue. Activities include the construction and maintenance of check dams to correct erosion and the maintenance of fences designed to exclude permitted cattle and pack stock from damaged areas to allow natural restoration. Such restoration has been performed for the same reasons in the Evolution Valley, but is essentially complete and the meadows there stabilized. Other areas subject to periodic stabilization activities include Halstead and Horse Corral Meadows.

2. Trails which presently pass directly through meadows will be rerouted through more stable soils and less fragile vegetation.

Where trails have created deep trenches through meadows, they will be eliminated and rehabilitated and the effected environment restored to its original condition. Meadow profiles will not be restored by the use of foreign material, i.e., abandoned eroded trail ditches in meadows will not be filled with rock or other material. Restoration methods will be designed to duplicate the original soil and vegetation type and profile (see Roads and Trails).

3. Pack stock carrying capacities, translated into estimated maximum grazing days, will be determined for each grazing area which can be utilized by stock without damage. These carrying capacities will form the basis for the allocation of stock use. Permits for stock use will be required. Grazing use will be accumulatively and currently recorded for all the rated use areas and summarized and plotted on an atlas by area. Estimated maximum grazing days allocated to areas will also be shown on the atlas. In this way, areas approaching their grazing day limitation and areas which may be relatively unused will be apparent. Once an area reaches its grazing day limit it will be closed and alternate grazing areas suggested. Until carrying capacities are formulated and the system described above established, the existing grazing regulations will be enforced.

4. All drift fences will continue to be maintained in good repair. Unnecessary fences will be removed. New drift fences will not be permitted without approval of the Superintendent.

5. Periodic updating of meadow studies initiated by Sumner in 1941 to determine improvement or deterioration of specific meadow conditions will continue. As previously mentioned herein, a current updating is underway.

6. The role of lodgepole pine in relation to mountain meadows, to the degree it may be defined upon completion of pertinent studies directed by Dr. Paul Zinke, University of California, in Rock Creek Meadows, will be a basis for developing management. The need for further related research will be determined from evaluation of Zinke's recommendations. No major lodgepole removal will occur until specific reliable information is available.

7. A determination of the actual ground area included by the legal description of the private inholding in Cahoon Meadow will be made. This will be done in cooperation with the Bureau of Land Management. The necessary action, including fencing by the private landowner to prevent cattle trespass, to protect Park resources will be taken. Monitoring of erosion and resource deterioration in Cahoon Meadow will continue. The location of the Park boundary in the Milk Ranch

area has been determined. A fence is under construction by the owner/permittee to correct the problem.

8. The condition and use of administratively used pastures will be monitored by resource technicians to recommend changes in use patterns which may be required to prevent overuse.

9. Monitoring of resource deterioration in Cahoon Meadow will continue including possible effects on downstream aquatic resources.

ROADS AND TRAILS

Within these Parks are approximately 113 miles of surfaced roads, 63 miles of dirt roads, 35 miles of surfaced trails and 755 miles of unsurfaced trails. In addition, there are four miles of unsurfaced trails and 1/4 mile of unsurfaced road within Devils Postpile National Monument. Part of the road system and much of the trail system was established prior to the time when there were any construction standards. As a result, roads and trails have been designed and constructed to a variety of standards. Where trails were built before the establishment of the Parks it is doubtful if any standards were used.

At present, roads and trails are regularly maintained by Park maintenance personnel. However, where deficiencies in road and trail design and construction practices occur, and where there are lack of funds to maintain roads and trails to standard, problems detrimental to Park resources (e.g., erosion) have occurred. The effects of routing trails through fragile meadow ecosystems as well as plans for relocating such trails are discussed under Meadow Restoration, Maintenance and Grazing, in this Plan. In repairing eroded trails, fill material, in some cases, has been dug up in meadows and other areas causing unsightly scars which must be ameliorated. A few road culverts have been poorly placed or inadequately maintained, resulting in erosion. The routing of roads through giant sequoia groves has resulted in serious impact on these prime Park resources. (See section Human Impact on Sequoia Groves.)

When roads or trails are abandoned, the road or trail surface must be prepared to prevent erosion to the surfaces and adjacent areas.

Further, where trails or roads have been abandoned, rehabilitation and restoration must insure a rapid return to a natural condition to effect their rapid assimilation with the natural environment.

Administrative Policies is quite clear regarding the importance of natural resource considerations in the design and construction of roads and trails. It states, ". . . the following considerations must precede approval of design and construction: 1. A professional ecological determination must be made that the resulting effects on Park values - including such aspects as wildlife habitat and mobility, drainage, stream flow, and the climatic effects of paved areas - will be minimal . . . A Park road is not one that merely conforms to standards of technical road-building excellence. Preserving the integrity of the landscape, respecting ecological processes, insuring

a fully rewarding visitor experience - these are the elements which dictate the means of visitor access and the development of design standards." The considerations described above should not be limited to new construction alone, but should be applied to existing road and trail systems as well.

Action Plan

1. All abandoned roads and trails will be treated by established soil and moisture conservation and engineering techniques to prevent the development of erosive conditions and to facilitate their return to a natural condition as rapidly as possible. Such practices include the construction of water turning devices, the loosening of compacted surfaces to facilitate natural vegetative regeneration and possible seeding with native species.

2. Before any new trails or roads are constructed, those to be replaced and abandoned or not maintained, will be treated as indicated in 1. above. Where feasible, all roads (other than the Generals Highway) within giant sequoia groves will be abandoned and the surrounding ecosystem rehabilitated. As physical developments are removed from giant sequoia ecosystems, access roads will be removed and returned to a natural condition.

3. All trails abandoned (not maintained) in the past will be treated as in 1. above. All system trails and roads will be maintained to prevent erosion of those developments and adjacent affected areas. All trail maintenance and soil and moisture conservation personnel will be trained in approved methods and techniques for rehabilitating and obliterating closed trails.

4. Resource technicians will perform continuing surveys of existing roads and trails to identify detrimental environmental impacts caused by the design, construction, or maintenance practices. As impacts are identified, plans will be made and implemented to eliminate the causes of the impacts and remove their effects where feasible.

5. The required "professional ecological determination" referred to above will be performed at the Park level prior to design and construction of all roads or trails or trail relocation activities.

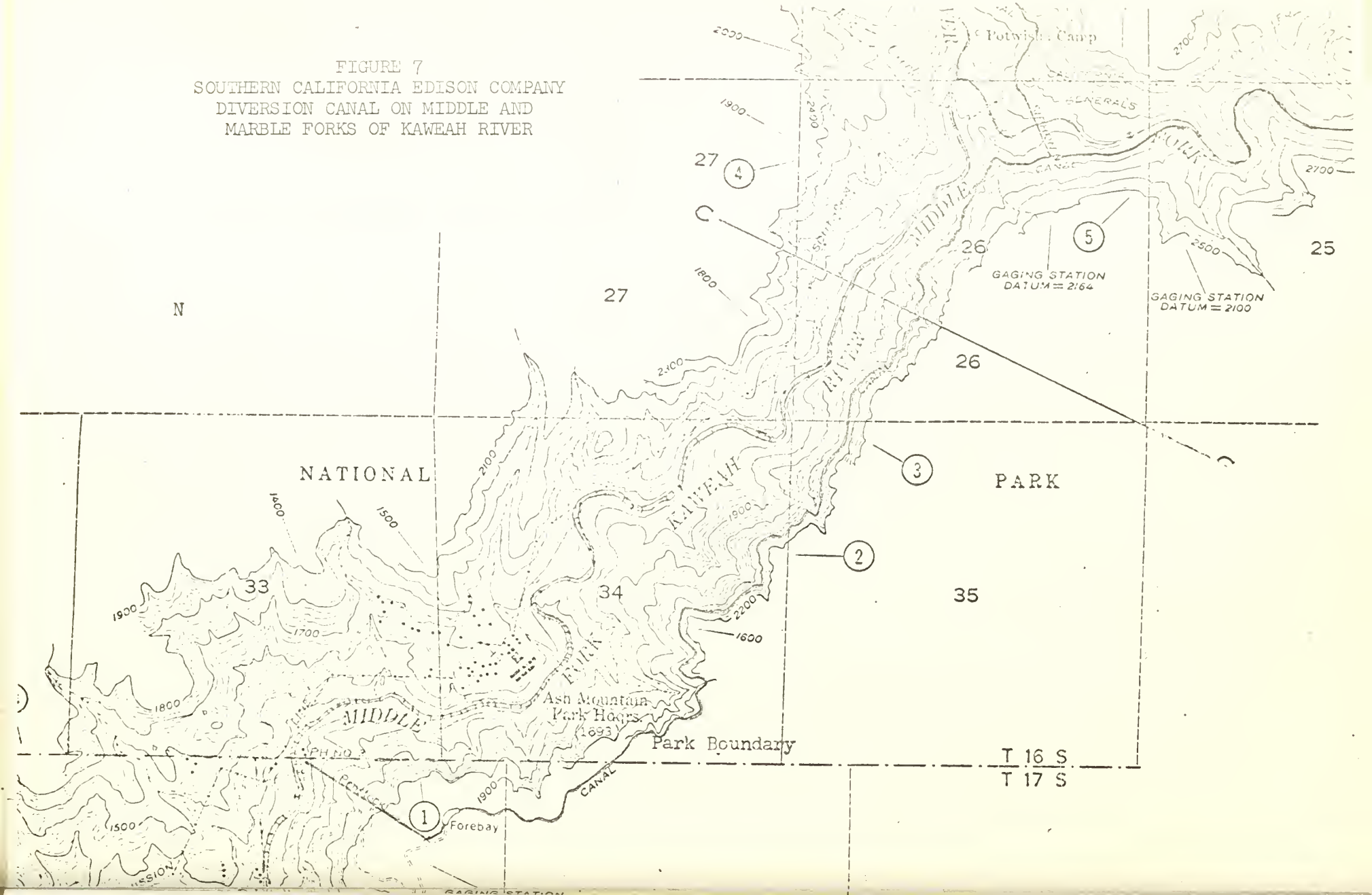
KAWEAH RIVER DIVERSION PRACTICES

Since 1913 water has been diverted from the Marble and Middle Forks of the Kaweah River for use in the generation of electricity. The diverted portion of river extends 4 1/2 miles upstream from Sequoia National Park boundary to the vicinity of Potwisha Campground. The current permit and concurrent Federal Power Commission license enables the Southern California Edison Company to operate the facilities until August 1974. Administrative Policies states that "Except where they involve existing rights recognized by legislation or agreement prior to the establishment of the area, or where they are authorized as being clearly in the national interest after all reasonable alternatives have been exhausted, the installation of electric power transmission lines . . . and other structures and facilities not directly related to park management and visitor use should be discouraged. . . . Where such non-park uses exist, or where they may be authorized . . . they should be eliminated as rapidly as possible through orderly and cooperative procedures with the permittees concerned."

This 4 1/2 mile stretch of the Kaweah River (Figure 7) is one of the few protected examples of unique foothill riparian ecosystem. In an effort to restore a semblance of naturalness to the aquatic ecosystem, studies conducted by National Park Service personnel in 1963 resulted in negotiated restrictions on water use. A minimum release established at that time is still in effect. During the months of July and August a minimum release of 20 cubic feet per second is received and during September through December a release of 11 cubic feet per second is allowed. Cooperative studies conducted by National Park Service, Fish and Wildlife Service, and the California Department of Fish and Game personnel in 1973 show that the aquatic habitat despite these required minimum releases, is still below adequate standards to sustain natural trout populations. Conclusions from the 1973 study indicate that 40 cubic feet per second would be necessary to furnish spawning habitat, resting habitat (frequently occupied by suckers at lower flow rates) and cover to sustain reproduction and growth of native trout.

The water works, bridges and attendent buildings, dams and walk ways are apparent to hikers and visitors who use the main Park road. Such developments are entirely out of context with a natural landscape. The conduit is a barrier to animal movements up and down the chaparral-covered slopes of the canyon. Finally,

FIGURE 7
SOUTHERN CALIFORNIA EDISON COMPANY
DIVERSION CANAL ON MIDDLE AND
MARBLE FORKS OF KAWEAH RIVER



the full recreational potential of the resource such as swimming and angling cannot be realized, as in the summer most of the water is diverted from its natural channel.

Objectives in resource management for this ecosystem are:

1. Return of water to its natural channel.

2. Restore the affected area to natural conditions.

Action Plan

1. Temperature studies will be carried out in summer 1974 to determine what temperature regimes would exist in the channel under full flow conditions.

2. Differences in available aquatic habitat between full flow and diverted conditions will be determined by aerial photo grammetric methods.

3. This Park will continue to recommend termination of the project. If it is necessary to compromise, a permit should be granted for no more than 10 years with provision for review after five years.

4. Upon project termination, all developments will be removed that will not result in excessive damage to the surrounding terrain and vegetation. Rehabilitation of the area will be according to the guidelines found under Landscape Management and Roads and Trails.

HUMAN USE OF THE WILDERNESS

The vast majority of the area comprising these Parks is de facto wilderness. Wilderness as defined by the Wilderness Act (Public Law 88-577, September 3, 1964) has also been referred to as "Back Country". Wilderness proposals for these Parks have taken several forms and over 90 percent of these Parks have been proposed for wilderness in the past. As yet, the Congress has not provided the legislation necessary to include proposed areas as designated wilderness. However, such designation is expected in the near future.

The location of these Parks relative to large population centers in southern California and relative availability of its wilderness areas from the east side of the Sierra Nevada has accounted for heavy visitor use. Table 2 illustrates visitor use in recent years, Table 3 shows recent use of pack and saddle stock. While the use of pack and saddle stock has remained essentially static for many years the increasing popularity of wilderness use by hikers is evident. The Parks required "Campfire Permits" for many years. These permits were indicators of visitation and areas of heavy use. As use spiraled upward, it became obvious that certain controls were necessary in order to protect Park resources from deterioration by human impact.

In 1961 a Back Country Management Plan for Sequoia and Kings Canyon National Parks by M. Thede, L. Sumner, and R. M. Leonard (unpublished N.P.S. report) was prepared. It was revised in 1963. Those Plans plus a number of other administrative reports including a Special Report on Range Management and Wildlife Protection in Kings Canyon National Park (unpublished N.P.S. report, 1941), Tourist Damage to Mountain Meadows in Sequoia-Kings Canyon National Parks, 1935 to 1948 a Review with Recommendations (unpublished N.P.S. report, 1948), both by Lowell Sumner, and A Report on the Status Changes and Ecology of Back Country Meadows in Sequoia and Kings Canyon National Parks (unpublished N.P.S. report, 1959), influenced wilderness management for a number of years.

By 1972 many aspects of the 1963 Back Country Management Plan had become outdated. In December 1972 the Regional Director, Western Region, asked for a new Back Country Management Plan which was prepared and submitted in May 1973.

On July 1, 1972, the old Campfire Permit was replaced by a Wilderness Permit. The permit is a joint permit issued by the National Parks and adjacent National Forests. In effect it pro-

Table 2

TOTAL YEARLY TRAVEL FROM FIRE PERMIT DATA

Year	Number of People	Number of Visitor Days	Number of Permits
1962	8,054	57,183	1,678
1963	8,248	54,688	1,856
1964	11,512	54,136	2,123
1965	10,018	38,650	2,577
1966	14,256	68,286	3,287
1967	11,436	66,117	2,762
1968	15,730	95,429	3,460
1969	13,363	72,446	2,988
1970	22,740	122,970	5,721
1971	44,160	207,788	10,640
*1972	50,995	192,857	14,570
*1973	42,221	149,891	12,060

*Data from Wilderness Permits. Prior to 1972 data taken from Park Campfire Permits.

Table 3

SUMMARY OF PACK AND SADDLE STOCK GRAZING

1963 - 1973

Year	Government		Concessioner		Private		Other Permittee		Total	
	#	AUM	#	AUM	#	AUM	#	AUM	#	AUM
1963	67	644	866	320	NR	NR	NR	NR	NR	NR
1964	58	500	1252	485	175	52	NR	NR	1485	1037
1965	57	171	183	174	426	64	943	310	1609	719
1966	58	306	183	111	249	31	978	403	1468	851
1967	57	308	42	11	178	18	942	330	1219	667
1968	58	464	143	99	209	24	1012	367	1422	954
1969	64	319	245	188	102	8	494	130	905	645
1970	87	494	165	116	217	26	1035	382	1504	1018
1971	73	520	165	98	187	18	871	252	1296	890
1972	76	504	165	114	56	19	888	245	1185	881
1973	90	605	165	110	256	35	806	210	1317	960

AUM = Animal Unit Month
NR = No Record

vided wilderness travelers with a single permit good for both National Park and Forest Service wilderness. The permit was designed for computer summary. Visits are coded by the number of days each visitor spends in wilderness management units of which there are nine in the two Parks (Figure 8). The computer program is designed to provide a read-out of the number of visitors and visitor days for each management unit.

On June 17, 1971, the Secretary of the Interior issued a statement on "A Second Century of National Parks" which included directives to limit use to protect resources. These Parks proposed a three stage plan.

In 1972 the first stage of the three phase plan was implemented; the popular Rae Lakes Loop in Kings Canyon National Park was subjected to use controls. Initially, the limit in numbers of visitors using the Rae Lakes Loop was to be determined by calculating a six year average of visitation from the period 1966 to 1971. This amounted to approximately 11,000. That figure was increased to 15,000 which was deemed more realistic by the Superintendent and Chief Park Ranger. Between June 16 and September 15, 1972, 15,000 people were to be permitted to utilize the Rae Lakes Loop. A daily limit was arrived at by dividing the total allowed visitation by the 90 days in the period. Camping was limited to existing sites where open fires were allowed; where gas stoves were used, visitors were given free choice of site. At the end of the period, May 1 - September 15, 11,081 visitors had been permitted to use the Loop (actually controls were not imposed until July 1). The descrepancy between this number and the total allowed was due to several reasons: 1. on some days the daily limit was not reached and the under run was not carried forward, therefore accumulating totals provided a sum less than the maximum allowed; 2. adverse weather on popular weekends; and, 3. use shifts because of reaction to controls or by suggestion of controlling rangers.

The second stage was implemented in 1973. A rationing system was extended to all of Kings Canyon National Park. Control of the Rae Lakes Loop as a separate program was dropped and the area incorporated within the Kings Canyon control system. It was at first determined that a maximum of 21,000 visitors should be permitted in that Park during the same period referred to above. A set figure was unrealistic as, for practical reasons, no limits were placed on numbers of visitors entering via the John Muir Trail, either coming from the south over Forester Pass or from the north through Piute Pass. Visitation, however, was controlled by limits imposed for trail entrances to the Park (Table 4). As of September 15,

FIGURE 8
WILDERNESS MANAGEMENT UNITS

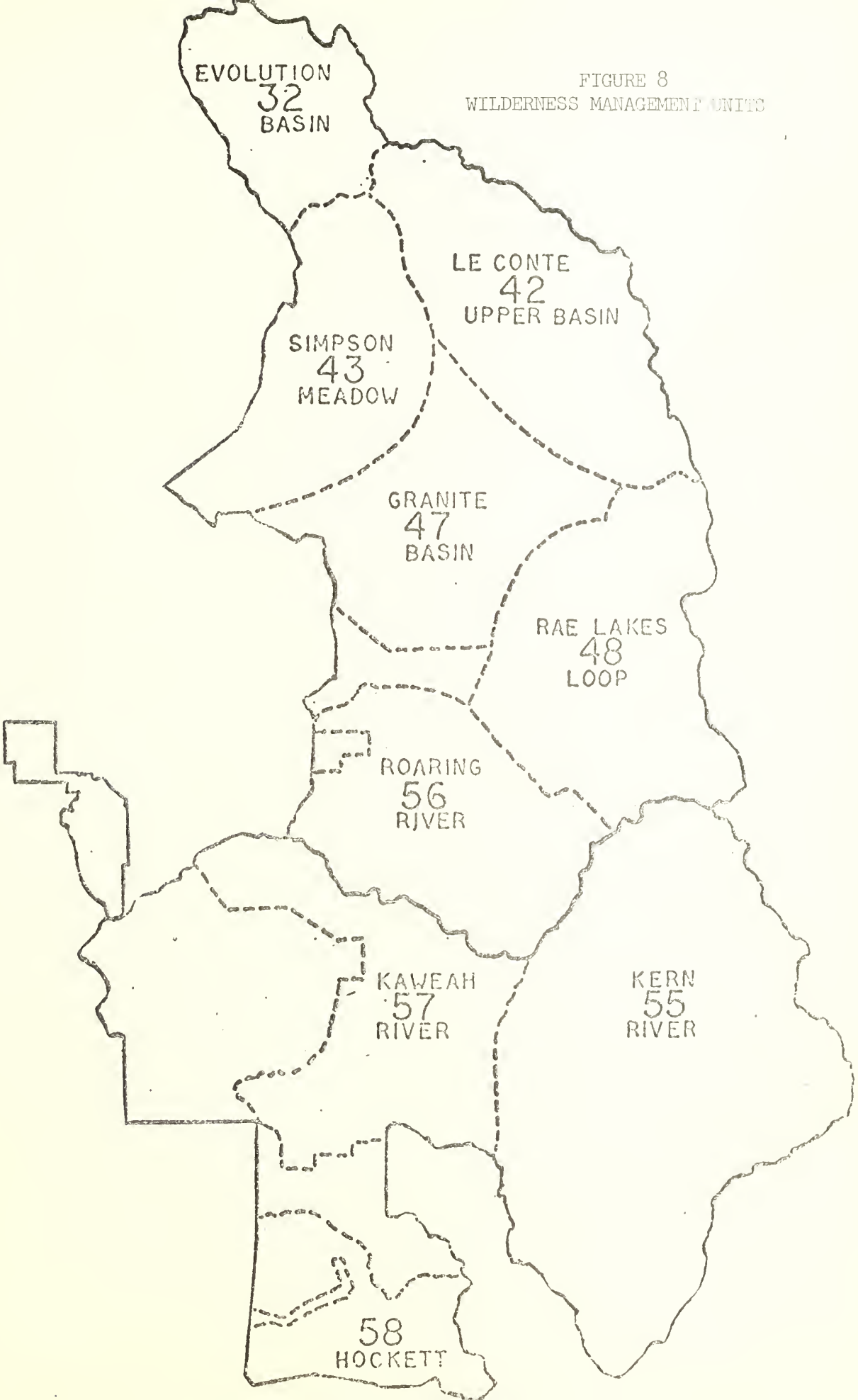


Table 4

DAILY LIMITS FOR INDIVIDUAL ENTRY POINTS
JUNE 16 - SEPTEMBER 15

	Trailhead	Daily Limit With Park Destination
1	North Lake	25
1	South Lake	60
1	Taboose Pass	25
1	Sawmill Pass	25
1	Baxter Pass	25
1	Onion Valley	60
1	Shepherd Pass	25
1	Whitney Portal	50
1	Cottonwood Lakes (New Army Pass)	25
1	Siberian Pass	25
4	Kern Ranger Station	25
2	Coyote Pass	25
2	Shotgun Pass	25
2	Franklin Pass	30
2	Sawtooth Pass	25
2	Timber Gap	50
4	Atwell Mill	25
4	Hockett Meadow	50
2	Wet Meadows	25
2	Quinn Ranger Station	25
4	Clough Cave	50
4	Middle Fork Kaweah	25
4	Crescent Meadow	40
4	Wolverton	25
4	Pear Lake	25
4	Twin Lakes	25
2	J. O. Pass	25
2	Sugarloaf	50
4	Bubbs Creek	30
4	Woods Creek	30
4	Copper Creek	30
4	Lewis Creek	30
3	Crown Valley	25
3	North Fork (Hell-for-Sure)	25
3	South Fork (Piute Entrance)	30

1. Associated with the Inyo National Forest
2. Associated with the Sequoia National Forest
3. Associated with the Sierra National Forest
4. Control by Sequoia and Kings Canyon National Parks

1973, 19,430 (from Wilderness Permit tabulation) visits were incurred within Kings Canyon National Park under the rationing system.

As the third phase of the program, Sequoia National Park was slated for inclusion in the system in 1974. Table 4 shows the number of daily visits the system would permit in Sequoia and Kings Canyon National Parks by trail entrance. As of this writing, funds to implement the rationing system in Sequoia National Park have not been allocated.

For full implementation the program requires Rangers to be stationed for the majority of the day, usually a minimum of 12 hours, at locations which control the major entrances to these Parks. It also requires staff support to manage the system.

The benefits from the existing system accrue by the fact that visitation is effectively limited to that experienced in some recent previous period. If use patterns continue as in the past, no significant increased resource damage should occur - in effect we should be "holding the line". These Parks had little experience in control of numbers of visitors permitted in wilderness, indeed, neither had any one else as it was a relatively new concept, often discussed but essentially untried. Like all new programs and all systems, it has certain frailities. Resource damage in wilderness areas characteristically occurs at particular locations where users congregate in the greatest numbers. Change of level of use of wilderness campsites or other popular stops already impacted is not provided for. Designed capability to adjust use by areas to restrict use of impacted areas and to divert use to less sensitive or non-impacted sites, is needed. A means of educating visitors as to ways they can reduce their impacts by more intelligent use of the wilderness should be provided. So far, this is essentially limited to chance visitor contacts while they are in the Parks - there is no formal educating program.

It will also be necessary to assess the degree of impact on specific areas, as reflected by biological indicators, and the ways changing numbers of users may alter that impact with time. Our current system does not tell the exact locations where visitors go; it provides information on visits by large areas (nine of which comprise all Park wilderness). More definitive use by site information is needed to correlate degree of impact on specific sites with a level of visitation.

Knowing what comprises impact and measuring the degree of which

it occurs and where it occurs is important. This information integrated with an active visitor education program and a permit system which can readily allow and distribute site use based on biologically based pre-established levels which will not result in resource deterioration, will allow maximum numbers of visitors consistent with natural resource maintenance.

Action Plan

1. Establish a criterion for rating environmental impact of use areas in terms of a degree of deflection through research and monitoring activities.

2. Establish controls on use from a natural (undisturbed) condition of areas as required to return them to standard (normal) environmental conditions.

3. Improve existing trailhead control of entries program to allow a flexible permit system designed to prevent impact by controlling the number of permits issued for impacted areas; and, to adjust visitor use to provide for use of non-impacted locations. The system should provide for retrieval of use information by specific sites.

4. Until action 3. above is implemented, continue with existing trailhead control program and extend it to Sequoia National Park by manning the major trailheads during the visitor use season as needed.

5. Establish a wilderness use educational program by which respective wilderness users can be exposed to a short program pointing out the ways which visitor behavior can ameliorate resource damage. An extension of this action would be to establish a requirement for the exposure to such information as a requirement for issuance of a wilderness permit.

CAVE MANAGEMENT

Sequoia and Kings Canyon National Parks contain over 30 known caves including some of the largest and most spectacular in California. In Caves of California, Halliday describes 21 Park caves including Crystal, Clough, Lilburn, and Soldier's Caves. Each of these caves is unique and should be protected at all costs. The following guideline which can be applied to cave management is in Administrative Policies:

> "The preservation of natural areas is a fundamental requirement for their continued use and enjoyment as unimpaired natural areas."

In the area of cave management this guideline presents a special problem. The complexity of the caves in these Parks as well as access to them, deterioration by visitor use, vandalism, litter, search and rescue, and other problems makes the cave resource one that is very difficult to manage. The primary objective for the management of caves in these Parks must consist of managing the resources of the caves to minimize any alterations of the existing biologic and geologic features.

In the past Crystal Cave has experienced heavy visitation. In 1973, 44,871 persons visited the cave. During the summer season guided tours are offered as part of the Park Interpretive Program every half hour during the day seven days a week. Attendant developments inside the cave include handrails, cemented walkways, and lighting. The management of Soldier's Cave has been oriented toward visitor safety. Technical climbing gear and more recently cave experience have been required before entrance was allowed. No other cave management policies exist in these Parks. In an effort to enforce the limited access to Crystal and Soldier's Caves each cave has been provided with a locked gate. To date, little attention has been given to cave management for protection of the cave resource. The fact that a cave might be irreversibly damaged by every human visit presents an additional problem.

Each visit to a cave can cause several types of damage. The brown stains of the formations found in Soldier's Cave as well as in several other Park caves was caused by dust from the floor stirred into the air and settling on the formation or the rubbing of muddy or dirty clothes against the formations. By merely touching the formation, human body oil permanently stains a speleothem. Human body waste causes a special problem. The waste is sensually dis-

pleasing and in a cave is slowly decomposed. Vandalism is another serious problem. A speleothem that required thousands of years to form is very brittle. One careless moment or one thoughtless act disallows countless others the chance to view the formation's priceless beauty. These types of damage can be eliminated in our cave resource only with adequate protective management.

A Management Policy Memorandum of Carlsbad Caverns National Park states, "Protection and enforcement of the rules and regulations pertaining to the preservation of natural features should, and must, be particularly strong in this Park where these features are dead and irreplaceable." Any damage done to a formation in a cave is permanent. There is far too much evidence of such damage in the many caves in these Parks.

Clough Cave demonstrates the result of vandalism. This once beautiful cave is now no more than a hole in the ground. Almost all the breakable formations are destroyed. The flow formations and columns are mud stained. This damage is irreversible. Halliday (1962) says of Clough Cave, "Because of its ease of access, vandalism has left mere vestiges of its former beauty." Only strong protective management will help to preserve remaining cave resources.

Action Plan

1. A thorough inventory of all Park caves and cave resources will be conducted to provide a basis for future management decisions.

2. All Park caves, except Clough, Crystal, and Soldier's, will be closed to general public access until recommendation can be made on management policies for each cave. Access will be allowed only for valid scientific or exploratory purposes as determined by the Superintendent. An application for access must be in advance in writing and include justification for the proposed entry. Readily accessable caves, including Lilburn and Paradise Caves, will be provided with locked gates. The entrance location of caves not readily accessable will not be public information.

3. Clough Cave, having been thoroughly and irreversibly vandalized, is excluded from the above restrictions and will continue to be open to free public access.

4. Crystal Cave will continue to be a part of the Park Interpretive Program. Visitors will be offered a guided tour during the summer months. The maximum group size will be 40 persons (a number estimated by Park Interpreters to be the maximum which can be adequately

handled by guides without risking damage to the cave resource). An emphasis will be placed on educating the public to the importance of conserving the cave resource.

SCIENTIFIC COLLECTING

The collection of natural objects in Sequoia and Kings Canyon National Parks and Devils Postpile National Monument is permitted only for scientific research purposes, subject to strict controls and only with the written permission of the Superintendent. In order to best preserve the natural resources, it is expected that whenever possible, the collection of natural objects (plants, animals and geological specimens) will be made outside the Parks.

Application for collecting permits in these Parks must be supported by a proposal covering the materials to be collected, the reasons for the benefits to be derived from the collection activities. Individual collections for private or personal use are not allowed and the collecting of specimens which are rare or endangered within these Parks, as determined by the Superintendent, are not permitted under any circumstances. All specimens collected must be deposited in a public museum or a scientific or educational institution as approved by the Superintendent.

All collecting must be done away from roads, trails and developed areas unless otherwise specified in the permit, and must be done in such a manner as not to attract attention or cause damage to the environment. The collection of wildlife (vertebrates) requires a special collaboration appointment. The collector may be required to furnish an inventory and locality description of any or all specimens he proposes to collect and to submit the collection for review once completed. These will be evaluated by Park Staff for possible coordination and inclusion into Park collections.

Action Plan

1. An application (Form WRO-107, see Appendix 4) with a supporting written proposal covering the reasons for collecting will be submitted to the Superintendent. If approved, the permit will be granted for a period not to exceed one (1) year and to expire at the end of each calendar year. They may be reissued upon receipt and approval of a report of progress to date.

2. Copies of all scientific and other publications resulting from collection activities in the Parks should be provided to the Superintendent upon completion.

Appendix 1

THE ROLE OF FIRE IN PRESERVATION OF NATURAL ENVIRONMENT IN SEQUOIA AND KINGS CANYON NATIONAL PARKS

The act which established the National Park Service provided that the purpose of Parks is to "conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." The Park Service is concerned with perpetuation of a natural environment and this is further brought out in "Administrative Policies for Natural Areas of the National Park System."

What of the effect of a natural fire on a natural environment? For untold years lightning fires have been an environmental factor in the forests of the Sierra Nevada mountains. These fires had important effects on various ecosystems, along with other environmental factors, and contributed to the development of the existing complex of forests and wildlife here when the first pioneers began to inhabit the area. Some of these forest communities now appear to be altered from past conditions. Historical records and research indicate that many unnatural vegetation changes have occurred because of the effective fire suppression practiced during the past 30-40 years or more. Frequent natural fires had the following beneficial effects:

1. Periodic removal of dead fuels, such as needles, leaves, branches, fallen trees, and dead stems of brush.

2. Periodic thinning of young trees by killing those of insufficient size to withstand fire. This lessened competition, allowed more growth for individuals, and produced a more open forest. The resultant condition favored the survival of non-shade tolerant sequoia and pine seedlings over shade tolerant white fir and incense-cedar. Now pine and sequoia seedlings are lacking in some areas and fir may eventually dominate, radically changing the make-up of plant and animal communities.

3. The effects described in paragraphs 1 and 2 above reduced the ground and understory fuels so that fires seldom developed into conflagrations destroying entire plant communities.

4. Forest litter was removed which exposed mineral soil, necessary

for the germination of seeds of some plants including those of the sequoia.

5. Seeds of many brush plants require heat stimulation in order to germinate in nature. Fire encouraged reproduction while at the same time stimulating sprouting in existing shrubs, thereby providing plentiful and nutritious forage for certain animals.

These are only some of the factors that fire affects. There are undoubtedly many more.

An endeavor to restore more natural conditions in the various ecosystems of Sequoia and Kings Canyon National Parks is underway. In 1968 a long-range environmental restoration program was initiated. A number of management units were established in various vegetative types. Burning under prescribed conditions has been carried out in a number of these units. Additional work is planned.

Inventories are being conducted and comparison with similar control plots will be made to record changes relative to vegetation and wildlife. A Research Biologist is in charge of the research program while management is under the direction of the Chief Park Ranger. The Park Superintendent coordinates their efforts. Information received from this project may be applied in the future to other areas and Parks.

In addition to the use of prescribed fire to restore natural conditions, beginning in 1968 all lightning fires occurring above 8,000 feet elevation in the Middle Fork of the Kings River drainage were allowed to run their course. In 1970 this management unit was enlarged to include virtually all contiguous Park lands above 9,000 feet elevation from the Kern and Kaweah drainages in the south to the South Fork of the San Joaquin River drainage on the north. In 1971, all of the Roaring River drainage south and east of Sugarloaf Creek and the Hockett Plateau from Cahoon Ridge east to the Hockett Crest were added to the management unit. The latest addition, in 1972, added the rest of the Roaring River drainage and the canyon of the Middle Fork of the Kings River east of Lost Canyon. This unit now includes nearly 70 percent of the area within these Parks.

Control measures will be taken only when threat to human life exists, where unacceptable loss of natural resource values may occur, or when spread to lands outside the management unit seems imminent. All such fires are under continual surveillance. Progress on these burns is being closely monitored for useful information for possible application elsewhere in the national parks and other wildland areas.

Appendix 2

HAZARD TREE RATING SYSTEM

The hazardous tree rating system used in these Parks comprises two basic elements. One relates to the tree itself, i.e., the relative degree of chance of imminent failure. There are three degrees, numbered 1 - 3, with 3 representing the highest chance for imminent failure. Assessment of a value depends upon many factors, such as the effects of the various pathogens on the structural soundness of trees, including roots, base, bole and limbs. Other considerations may be mechanical structural defects such as damage from lightning, heavy equipment, etc.

In some cases an additional value point may be added if a tree exhibits an unusually severe lean. As an example, a tree affected by a pathogen causing extensive rot of the main bole and which also leaned heavily, would be given a value of 3 for the structural defect and 1 for the lean, with a final value of 4. This value would indicate the chance of imminent failure was of the highest category.

Element number 2 relates to the type or extensiveness of damage and/or injury which would probably occur if the tree failed. The values for this element are similarly rated 1 - 3, with 3 being the highest, i.e., a tree rated 3 under this element could be expected to do extensive damage or cause injury or death upon failure. As an example, a large tree leaning over a cabin or a number of campsites would be rated as a 3. One on the periphery of a campground leaning away from campsites would be rated as a 1. If it failed, its chance of causing extensive damage and/or injury would be low.

The value for both elements is combined for each tree, and it results in a combined value which is equivalent to the priority for removal. The highest priority is a 7, and a 7 indicates a highly defective leaning tree which will cause extensive damage and/or injury upon failure. The lowest priority which could be assessed is a 2.

Outstanding features of the system used are:

1. When the system is applied by knowledgeable technicians, experience over the years has shown that priority values arrived

at for given trees are normally the same, but in any event seldom differ by more than one point. Assessment of priority can be considered reliable.

2. By assigning priorities to individual hazards, funds which may be available may be expended most efficiently. Trees whose failure is most imminent and in failing will cause the most extensive damage and/or injury may be removed first.

Appendix 3

GRAZING AND LIVESTOCK REGULATIONS FOR SEQUOIA AND KINGS CANYON NATIONAL PARKS 1974

Overuse of some popular or fragile sections of the backcountry has made it necessary to restrict public and government grazing in certain areas. We shall appreciate and expect your cooperation as these restrictions are the only way of preserving the very scenic values that so many visitors come to enjoy.

GENERAL

Twenty head is maximum limit without permission from Superintendent.

Loose herding is prohibited except as necessary for safety while crossing steep rocky passes or where the exposure is great and there is danger of animals falling off the trail.

SEQUOIA NATIONAL PARK

GIANT FOREST AREA: The following areas are closed to grazing; Alta Meadows, Crescent Meadow, Cahoon Meadow (Silliman Creek Watershed), Halstead Meadow, and within a radius of five (5) miles of Giant Forest Village. At Willow Meadow, grazing is not to exceed two (2) nights per party per trip. Stock prohibited on the High Sierra Trail from Crescent Meadow to the Wolverton cut-off junction.

LAKES TRAIL AREA: (Pear Lake, Moose Lake) Open to stock for day use only.

MIDDLE FORK KAWEAH: Redwood Meadow. Grazing limit 48 hours; stock limit seven (7) head per party.

HOCKETT MEADOW AREA: South Fork and Tuohy Meadows. Parties with more than twelve (12) head are limited to a 48-hour stay.

KERN CANYON AREA: Junction Meadow closed to grazing. Upper Funston Meadow, no grazing before June 15; grazing limit 48-hours per party per trip. Lower Funston Meadow, no grazing before June 1. Grazing limit 48-hours per party per trip. Kern River Administrative Pasture closed to the public. No picketing permitted in the Kern Canyon.

CRABTREE MEADOW AREA: Timberline Lake closed to grazing and camping. Guitar Lake limited to grazing by burros and walking mule parties only. Crabtree Lakes closed to stock travel. Parties with twelve (12) head or more will be advised by the Crabtree Meadow Ranger as to where to graze.

MT. WHITNEY TRAIL: Closed to stock from one (1) mile above Guitar Lake to Mt. Whitney Summit.

KINGS CANYON NATIONAL PARK

ROARING RIVER AREA: Scaffold Meadow, not to exceed twelve(12) head per party for two nights. The Scaffold Meadow Administrative Pasture is closed to the public and restricted to Government use, as is the small fenced pasture near the Roaring River Ranger Station. The fenced pasture at Horse Corral Pack Base is restricted to Government use.

CLOUD CANYON-CEMENT TABLE AREA: Stock limited to twelve (12) head per party. Grazing limit two days per party per trip in this area.

CEDAR GROVE AREA: South Fork of the Kings - no grazing on the floor of the valley from the Park boundary to Bubbs Creek Bridge.

EAST LAKE: Lake shore closed to all grazing; stock must be kept above East Creek drift fence.

PARADISE VALLEY: Closed to grazing of pack and saddle stock. Burros and walking mules parties permitted to graze overnight only. No picketing permitted.

CASTLE DOMES MEADOW: One day's grazing only. Limit of twelve (12) head per party. No picketing permitted.

RAE LAKES AREA: Closed to pack and saddle stock grazing. Burros and walking mules parties permitted to graze one (1) night only. Grazing permitted below the Baxter Creek Trail Junction. No picketing of stock on the Rae Lakes Loop.

SIXTY LAKES BASIN: One day's grazing only. Stock limited to twelve (12) head per party. No picketing permitted.

CHARLOTTE LAKE AREA: The meadows at the upper end of Charlotte Lake (the southeast end) are closed to all grazing. The first big meadow below the lake is closed to all grazing, and stock parties are requested not to allow their stock to cross the meadow. Graz-

ing is permitted along Charlotte Creek below the drift fence. No picketing permitted.

KEARSARGE-BULLFROG BASIN: Closed to grazing. Bullfrog Lake is closed to camping.

VIDETTE MEADOW: No grazing before June 15. Two (2) wrangle horses per party may be kept in Vidette Meadow; the remainder of the stock must be held above the East Vidette drift fence. Burros and walking mules parties limited to 48-hours grazing. No picketing permitted.

McCLURE MEADOW: No grazing before August 1. Grazing permitted in Evolution Meadow. No picketing permitted. Maximum number of stock per party is 20 head.

COLBY MEADOW: No grazing before August 1. Grazing permitted in Evolution Meadow. No picketing permitted.

EVOLUTION LAKE: Closed to grazing of pack and saddle stock. Burros and walking mules parties allowed one (1) night's grazing.

McGEE LAKES: Closed to stock travel above the McGee Canyon Meadow beginning at the 10,400 foot level.

Form WRO-107
(March 1973)

United States Department of the Interior
National Park Service, Western Region

APPLICATION FOR PERMISSION TO COLLECT
SPECIMENS OF PLANTS, ROCKS, MINERALS, AND ANIMALS

Name of Area	Date
Name of Applicant	Home Address
Representing (Name of Institution)	Period of Collecting From To

Specimens to be Collected (Type & Quantity)

Other Applicable Collection Permits: Federal:	State:
Agency: No: Expir. Date:	Agency: No: Expir. Date:

Reason for Collecting within this Area

Place where Specimens are to be Deposited

I, the applicant, having read the conditions on the reverse of the permit relating to collections within areas administered by the Western Region of the National Park Service, agree that, if the permit is granted, I will comply with all the conditions stated therein.

Signed _____

TO BE FILLED IN BY ISSUING OFFICE ONLY - DO NOT WRITE BELOW THIS LINE

Approved for Collecting following Specimens (Type & Quantity)

Locality of Collecting Limited to:	Permit Expiration Date
Special Conditions or Restrictions:	Copies of this permit sent to appropriate State and other Federal agencies, if applicable? Yes _____ No _____

Recommended by (Signature and Title)	Approved by (Signature of Supt.)	Date Approved

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United States Department of the Interior
National Park Service, Western Region

COLLECTING PERMIT

In Accordance with the Conditions and Restrictions Appearing on the Back, Permission is Granted:

Name of Collector	To Collect within (Area)	Date Issued

To Collect the following Specimens (Type & Quantity)

Locality of Collecting Limited to:	Permit Expiration Date
Special Conditions or Restrictions:	

Approved (Signature)

Superintendent,

The collecting of rare or endangered natural objects, if permitted at all, will be allowed only when approval has been obtained from the Regional Director of the Western Region, National Park Service, San Francisco, California.

THIS PERMIT MUST BE CARRIED AT ALL TIMES WHILE COLLECTING. SEE REVERSE FOR CONDITIONS AND RESTRICTIONS.

PERMIT STIPULATIONS AND CONDITIONS

It is the intention of the National Park Service to further scientific research within the areas administered by it, and to cooperate with technical workers to the fullest extent compatible with its charge to preserve all species of flora and fauna and all geologic material in a natural state, insofar as is possible.

1. This permit applies only to animal life, plants, rocks, minerals or other natural objects. Archeological and paleontological materials may not be collected under this permit. Collections of wildlife in Yosemite, Sequoia, Kings Canyon, Lassen Volcanic, Haleakala and Hawaii Volcanoes National Parks require non-Federal employees to be appointed as collaborators prior to issuance of a collectors permit.

2. The collections shall be used for scientific or educational purposes only, shall be dedicated to public benefit, and shall not be used for personal or commercial profit.

3. All collecting must be done away from roads, trails, and developed areas, unless such localities are specified in the permit. The collecting shall be conducted in such a manner as not to attract attention or to cause damage to the environment. Because of the scarcity or importance of some specimens, Service officials may designate the kind, number and sizes of specimens which may be collected, and any other restrictions deemed necessary.

4. The National Park Service reserves the right, in the interest of science, to designate the depository of all specimens removed from its administered areas within the Western Region and to approve or restrict transfers of specimens between depositories. The National Park Service also reserves the right to designate the U. S. National Museum as the depository of any type specimen after the collector has made necessary studies and published the results of his research thereon.

5. The Superintendent may require the permittee to furnish an inventory and locality description of any or all specimens proposed to be collected before they are removed and, after the collection is assembled, to submit it for examination.

6. Use or Disposition of Preserved Specimens: The collected specimens shall be deposited in a permanent public museum or in the exhibit, study or type collections of scientific or educational institutions. They must be suitably recorded in a permanent file and must be available to the public.

7. A copy of all scientific and other publications resulting entirely or in part from collection activities resulting from the issuance of this permit will be furnished to the Superintendent of the issuing park or other specified official of the National Park Service.

NATURAL RESOURCES PROJECTS PROGRAMMING SHEET

July 9, 1974
(Date)

ia and Kings Canyon National Parks, California
(Park and State)

(2) AREA PRIORITY	Ref. No.	(3) PROJECT PROJECT TITLE	Year 1(76) NPS M.Y.	Year 1(76) COST in $1000	Year 2(77) NPS M.Y.	Year 2(77) COST in $1000	Year 3(78) NPS M.Y.	Year 3(78) COST in $1000	Year 4(79) NPS M.Y.	Year 4(79) COST in $1000	Year 5(80) NPS M.Y.	Year 5(80) COST in $1000	RSP	(15) Form No. and Date Submitted 10-250	10-237	10-238	(16) No. of Work Order or Contract
1		Resource supervision, evaluation, inspection and monitoring by Resources Management Specialist, Fish and Wildlife Specialist, Forestry and Biological Technicians.	3.5	85	3.5	85	3.5	85	3.5	55	3.5	55	-	-	-	-	Existing Operation
2		Tree Hazard Abatement	3.0	33	3.0	33	3.0	33	3.0	33	3.0	33	-	-	-	-	Existing Operation
3		Forest Pest Control	4.5	54.1	4.5	54.1	4.5	54.1	4.5	54.1	4.5	54.1	-	-	-	-	Existing Operation
4		Soil and Moisture Conservation	1.8	21	1.8	21	1.8	21	1.8	21	1.8	21	-	-	-	-	Existing Operation
5		White Pine Blister Rust Control	1.7	13.6	1.7	13.6	1.7	13.6	1.7	13.6	1.7	13.6	-	-	-	-	Existing Operation
6		Black Bear Research	.0	10.0									-	-	-	-	Existing Operation
7		Sequoia Ecology	.0	15.0									-	-	-	-	Existing Operation
8		Rae Lakes Research	.0	10.0									-	-	-	-	Existing Operation
9		Natural Science Support	2.0	16.7	2.0	16.7	2.0	16.7	2.0	16.7	2.0	16.7	-	-	-	-	

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10		Giant Sequoia Fire Management	6.6	59	6.6	59	6.6	59	6.6	59	6.6	59	-	-	-	-	
11		Natural Fire Runoff	.0	10									-	-	-	-	
12		Staff Support to Fisheries and Wildlife Programs	.8	14.9	.8	8.9	.8	8.9	.8	8.9	.8	8.9	-	-	-	-	
13		Bighorn Sheep Investigation	.0	15	.0	15							-	-	-	-	
14		Mule Deer Research	.0	8									-	-	-	-	
15		Reestablish Natural Ecosystems Altered by Exotic Beaver	1.2	12	1.2	12	1.2	12	1.2	12	1.2	12	-	-	-	-	
16		Natural Fire Research	.0	24									-	-	-	-	
17		Professional Support to Resources Management Activities	1.0	16.8	1.0	16.8	1.0	16.8	1.0	16.8	1.0	16.8	-	-	-	-	
18		Kaweah River Monitoring	.3	8.7	.3	2.7	.3	2.7	.3	2.7	.3	2.7	-	-	-	-	
19		Reestablish Natural Vegetation Mosaic in Campgrounds			.9	8	.9	8	.9	8	.9	8	-	-	-	-	

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20		Wilderness Carrying Capacity			.5	10.5	.5	10.5	.5	10.5	.5	10.5	-	-	-	-	
21		Remove Abandoned Fire Lookouts				12							-	-	-	-	
22		Remove Exotic Beaver				5							-	-	-	-	
23		Preserve Mountain Meadow Resources			1.6	16.1	1.6	16.1	1.6	16.1	1.6	16.1	-	-	-	-	
24		Remove Hazard Tree Backlog			3.0	40	3.0	40	3.0	40	3.0	40	-	-	-	-	
25		Smoke Research				10							-	-	-	-	
26		Dwarfmistletoe Control - Cedar Grove			1.2	12.9	1.2	11.4	1.2	11.4	1.2	11.4	-	-	-	-	
27		Protection of Cave Resources			.4	5.5							-	-	-	-	
28		Blister Rust Control by Prescribed Burning			1.6	16.9							-	-	-	-	
29		Pristine Vegetation Patterns						20					-	-	-	-	

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30		Wilderness Use Monitoring					1.0	9	1.0	9	1.0	9	-	-	-	-	
31		Support for Endangered Species Program					.5	7	.5	7	.5	7	-	-	-	-	
32		White Pine Blister Rust Monitoring					.7	7	.7	7	.7	7	-	-	-	-	
33		Sociological Study of the Wilderness Experience						17.5					-	-	-	-	
34		Restore Abandoned Trails and Roads to Natural Conditions					.6	6.5	.6	6.5	.6	6.5	-	-	-	-	
35		Mountain Lion Research								9.5			-	-	-	-	
36		Removal of Abandoned Fences from the Wilderness							1.5	20	1.5	20	-	-	-	-	
37		Plant Ecology Support							1.8	17.4	.9	7.9	-	-	-	-	
38		Cave Inventory										10	-	-	-	-	
39		Wolverine and Fisher Research										12.5	-	-	-	-	

REFERENCES CITED

Biswell, Harold H. 1961. The big trees and fire. National Parks Magazine 35:11-14.

Engbeck, Joseph H. 1973. The enduring giants. University of California, Berkeley. 119 pp.

Establishing Act for Sequoia National Park. September 25, 1890. 51st Congress, U.S. of America.

Establishing Act for Kings Canyon National Park. March 4, 1940. 76th Congress, U.S. of America.

Griffin, James R., and William B. Critchfield. 1972. The distribution of forest trees in California. U.S. Forest Service Research Paper PSW-82/1972, Berkeley, California.

Hall, J. Alfred. 1972. Forest fuels, prescribed fire, and air quality. U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 44 pp.

Halliday, William R. 1962. Caves of California. A Special Report of the Western Speleological Survey in Cooperation with the National Speleological Society, June 1962, Copy 167 of 500 printed.

Hartesveldt, Richard J. 1963. Reconnaissance study of the effects of human impact upon moderately to heavily used sequoia groves in Sequoia and Kings Canyon National Parks. Report to Regional Director, Western Region, National Park Service.

Hartesveldt, Richard J. 1964. Fire ecology of the giant sequoia: controlled fires may be one solution to survival of the species. National History Magazine 73:12-19.

Hartesveldt, Richard J., H. T. Harvey, H. S. Shellhammer, and R. E. Stecker. 1970. Giant sequoia ecology. Final Contract Report to National Park Service.

Hartesveldt, Richard J., H. T. Harvey, H. S. Shellhammer, and R. E. Stecker. In Press. The giant sequoias of the Sierra Nevada. Washington:United States National Park Service.

Hendee, John C., and Robert C. Lucas. 1973. Mandatory wilderness permits: a necessary management tool. Journal of Forestry, Vol. 71, No. 4, April 1973.

Kilgore, Bruce M. 1970. Restoring fire to the sequoias. National Parks Magazine 44(Oct.):16-22.

Kilgore, Bruce M. 1972. Fire's role in a sequoia forest. Naturalist Centennial Issue Number 1, Vol. 23, spring, 1972:26-37.

Kilgore, Bruce M., and George S. Briggs. 1972. Restoring fire to high elevation forests in California. Journal of Forestry 70(5):266-271.

Leopold, A. S., S. A. Cain, C. M. Cottam, I. N. Gabrielson, and T. L. Kimball. 1963. Wildlife management in the National Parks. American Forester 69, 4:32-35, 61-63.

Rundel, Philip W. 1971. Community structure and stability in the giant sequoia groves of the Sierra Nevada, California. American Midland Naturalist 85:478-492.

Rundel, Philip W. 1972. Habitat restriction in giant sequoia: the environmental control of grove boundaries. American Midland Naturalist 87:81-99.

U.S.D.I., National Park Service. 1965. Compilation of the administrative policies for the National Parks and National Monuments of scientific significance. U.S. Government Printing Office, Washington, D. C. 138 pp.